METHODOLOGIES TO IMPROVE PRODUCT LIFE CYCLE DECISION MAKING IN THE TELECOMMUNICATIONS INDUSTRY

A thesis submitted for the degree of Engineering Doctorate

by

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Sections
A - Executive Summary
B - Thesis Document

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Abstract

As pressure from regulation and customers increases on telecommunications equipment manufacturers and service providers to reduce the hazardous material content of telecommunications products and generally improve environmental performance, new methods for Product Life Cycle Management are required.

Supplier and component environmental evaluation are vital and fundamental elements of any Product Life Cycle Management programme, as is the capture of data from the supply base.

The information that needs to be captured from the supply base to meet the requirements of customers of telecommunications equipment providers; to meet the requirements of legislation; and to provide data for improving ecodesign and facilitating product-focused continual improvement for ISO 14001 has been identified.

A method for capturing data from the supply base has been developed and recommendations made for implementation.

A hierarchical supplier and component eco-evaluation methodology has been developed and tested. This methodology incorporates supplier environmental management performance, component inherent human toxicity, ecotoxicity and resource depletion. It provides component qualifiers and purchasers with a method of supplier environmental performance comparison and enables this criterion to be integrated with existing criteria such as quality and cost in the component and supplier selection decision-making process.

Recommendations are made regarding the implementation of an industry-wide system to enable the capture of detailed product material composition data from the supply chain and the implementation of the eco-evaluation methodology to identify the supplier that has superior environmental performance. The result will be enhanced decision-making in product design and manufacture, improved transparency in communication to customers and more informed decision-making at the end-of-life stage of the product life cycle.

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Glossary of Terms

ABS	Acrylonitrile Butadiene Styrene (polymer)
BiE	Business in the Environment
BoM	Bill of Materials (parts list)
Business Functions	Department within a company e.g. Manufacturing
CFC	Chloro-Fluoro-Carbon
DfE	Design for Environment
Eco-Indicator	Measure of environmental performance
EEE	Electrical and Electronic Equipment (Directive)
EIA	Electronic Industries Association
EICTA	European Information and Communication Technology Association
EIME	Environmental Information Management Explorer (DfE Tool)
EMS	Environmental Management System
EPOA	Environmental Performance Opportunity Assessment
GreenPack	Nordic supply chain management initiative
IEC	International Electrotechnical Commission
ISO 14001	International Standards Organisation Environmental Management System Standard
IVF	Swedish Institute of Production Engineering Research
LCA	Lice Cycle Assessment
Livelink	Data Management software
LOB	Lines of Business
NED	Nortel Eco-Designer
OEM	Original Equipment Manufacturer
PACE	Product Assurance and Component Engineering (Nortel Networks component qualification department)
PCB	Printed Circuit Board
PECC	Product Environmental Compliance Checklist
PERI	Public Environmental Reporting Initiative
PLCM	Product Life Cycle Management
RoHS	Restriction on Hazardous Substances (Directive)
WebCrop	Data management software
WEEE	Waste from Electrical and Electronic Equipment (Directive)

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Executive Summary

1.0 Introduction

This executive summary provides an overview of the research undertaken to meet the requirements for the award of Engineering Doctorate in Environmental Technology from the Brunel University and University of Surrey EngD programme.

The research focuses on the development of mechanisms for capturing data from suppliers of electronic components to the telecommunications industry and using these data in decision-making for component and supplier selection, the generation of product material profiles, and improving the environmental performance of telecommunications products and the companies and supply chains that manufacture them.

The discipline of Environmental Supply Chain Management has been developing over the last five years and the main objective of any work conducted in this area is to introduce environmental performance as a criterion into the procurement process. The development of supplier and product eco-evaluation methods naturally overlaps with other product or service environmental assessment methodologies such as Life Cycle Assessment and Ecodesign. The research presented here is an extension of the body of knowledge on Life Cycle Assessment and provides methodologies for integration with ecodesign practices. The overall work provides a contribution to the field of Product Life Cycle Management, which encompasses all product-oriented environmental performance improvement practices.

The research was conducted at a strategically important time for the telecommunications industry. Telecommunications products and services providers are under increasing pressure from both regulators and customers to provide more information on the environmental impacts of products and services and to introduce initiatives to improve environmental performance. The mandatory take-back of electronics products by manufacturers and the banning of certain hazardous materials within them are imminent in Europe and the industry is seeking solutions that are efficient and can be applied to a global business model.

A significant volume of research has been conducted in the field of Life Cycle Assessment and ecodesign and still continues. However, when the research project started only limited research had been conducted on environmental supply chain management. Over the period of the research project, a wide range of research has been conducted by the research community and much of this work provides interesting comparison to the results and recommendations made in this body of work. A comprehensive literature review is provided in Chapter 4 of the thesis document.

The overall objective of the research was to investigate the feasibility of integrating supplier-specific product-specific environmental data into the ecodesign process and the Product Life Cycle Management (PLCM) system of Nortel Networks (the sponsoring company). The core objectives included:

- The identification of what information needs to be obtained from suppliers to meet the requirements of ecodesign, legislation, customer requests and ISO 14001;
- The development of methods to obtain the information from suppliers; and
- The development of methods for how the supplier information can be used by the Nortel Networks design community, purchasing function, ISO 14001 systems and sales functions.

The remainder of this executive summary provides a summary of the research undertaken, the key findings and highlights the contributions to knowledge.

2.0 Portfolio Structure

The executive summary is just one document in the EngD portfolio. It provides a summary of the research. The portfolio consists of several documents grouped into sections. These include:

- Six month reports;
- Research publications;
- Module assignments; and
- Support documents.

The detail of the research is introduced, presented and discussed in the portfolio thesis document and from the thesis, reference is made to various documents in the portfolio. A complete description of the portfolio structure is provided in Chapter 1 of the thesis document.

The core documents in the portfolio are the executive summary, the thesis and the research publications and this is the recommended order of reading. The six-month reports should be regarded as a log, or diary, of events throughout the entirety of the research project. They provide an account of how the research progressed and changed focus but are not designed to be a presentation of the research thesis.

3.0 Research Methodology

The research was regarded as being very much "hands-on" or "real world" in nature. The majority of the research was not conducted in isolation but involved considerable interaction with Nortel Networks business functions. This means that the research engineer could be considered part of an expanded team. The team was used as an essential source of information and was also the final customer for the research results and recommendations. This approach was considered essential if the methods or tools developed and proposed were to stand any chance of being implemented and integrated into current or future systems within the company. Ensuring the "team" remained informed of all progress and was included in any decision-making that resulted in impacts upon the project was very important. In addition it was necessary to remain abreast of all developments that may have affected the project as both the ecodesign and the telecommunications fields are fast moving and dynamic.

The research methodology is described in detail in Chapter 3 of the thesis document. The process consists of defining the problem, investigating relevant previous work conducted in the field, generating options, planning, implementing, testing and reviewing solutions in a cycle until a decision is made to implement the recommended solution.

The research methodology described provided a top-level research framework for the research project. The project was driven by a core hypothesis that equates to the problem definition phase of the methodology framework described.

Hypothesis

Supplier product and company environmental data can be integrated into the Ecodesign and Product Life Cycle Management systems of Nortel Networks or any telecommunications network solutions company.

To prove or disprove this hypothesis a set of research questions was generated with associated programmes of work (see Figure E1).

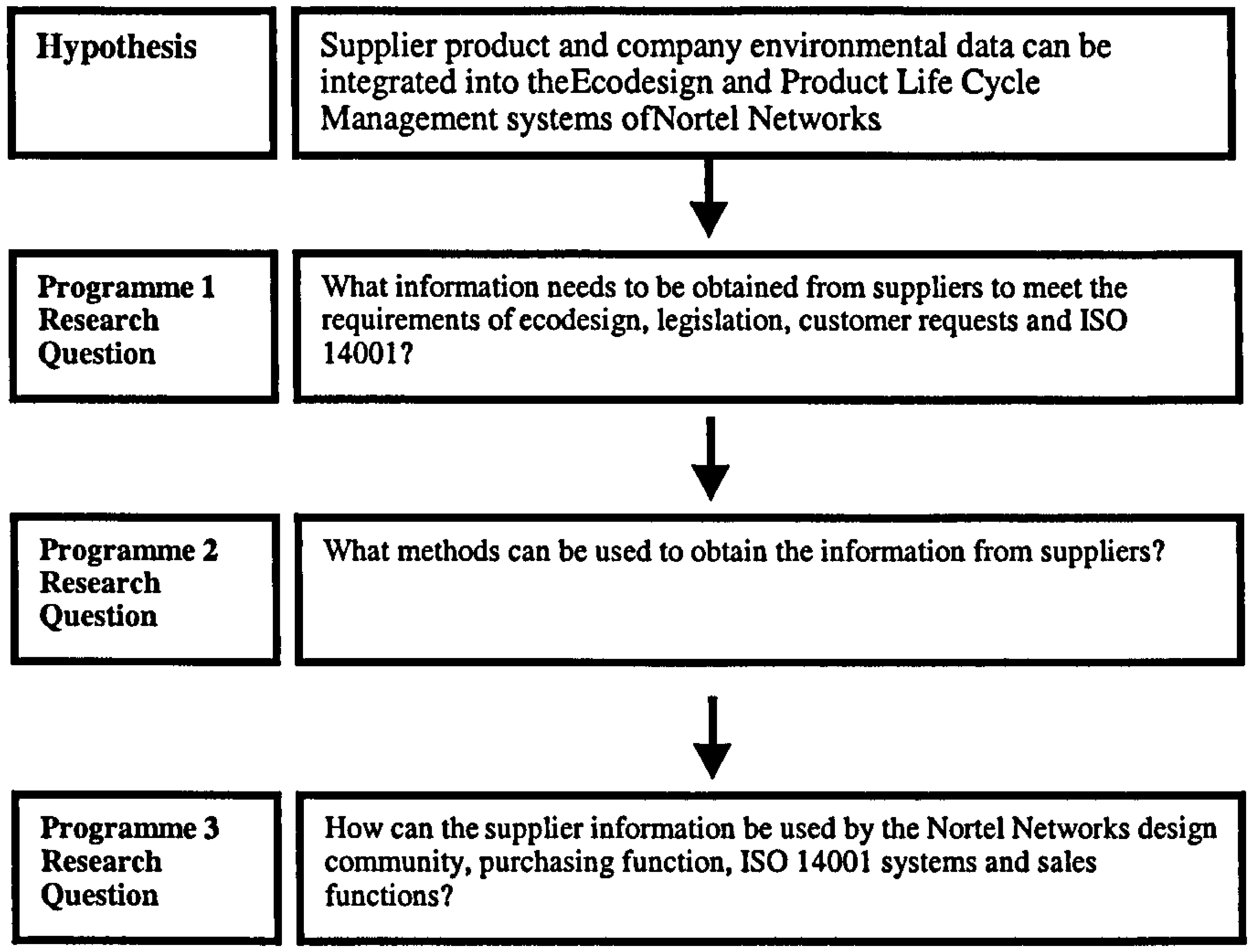


Figure E1. Research questions and programmes of work

Each of the research questions leads to a programme of work. The three programmes were broadly conducted in chronological order although elements of concurrency did emerge as the project progressed. A project management plan was generated to provide a detailed road-map in terms of specific objectives, activities and time frames for completion of each programme and of the complete project. Project details were also documented in a Nortel Networks "Work Package Description" for adherence to internal quality management requirements. The project management plan can be seen in six-month report number 4 (second year dissertation).

The programmes of work were broadly chronological and planned in detail (see six month reports). The research required interaction with many business functions within Nortel Networks and suppliers of Nortel Networks. Communication to all relevant business units was a fundamental component of the project. In addition, due to the sensitive nature of some of the elements of the research, certain restrictions were placed upon the researcher, which inhibited to some degree, the work that could be conducted, particularly in terms of implementation. This is an acceptable part of research conducted in a commercial context.

4.0 Data Required from the Supply Chain

Programme 1 of the research project focused on activities designed to determine the information that needs to be obtained from suppliers to meet the requirements of ecodesign, legislation, customer requests and ISO 14001 and therefore, to advance Product Life Cycle Management.

In terms of meeting the environmental information requirements of customers and in particular the product environmental information requests in customer environmental questionnaires it is suggested that only detailed component-specific supplier-specific data will suffice. Using generic averaged data on representative components is not considered to provide the necessary degree of accuracy and certainty.

To identify the product environmental information requirements of customers' data from two research tasks were used:

- Tabulated customer requests/proposals for contract bids;
- Detailed analysis of selected customer environmental questionnaires.

In addition, further work was conducted on the development of a questionnaire for customers of Nortel Networks to investigate exactly how customers used the information requested and whether it did actually influence their decision to approve and award a bid for contract. Unfortunately, due to strategic decision-making within Nortel Networks this questionnaire was not given approval for use.

Observations from the tabulated customer requests for contract bids were:

- It can be seen that the customer environmental requirements or requests for information vary considerably; and
- To varying degrees customers have inquired about the environmental performance of Nortel Networks in fifty-five contract bids over 21 months (1998 – 1999), worth US$ 8 billion (known bid values only). This compares to the previous 28 months (September 1995 – December 1997) with twenty-four contract bids worth US$561 million.

A selection of customer questionnaires received prior to December 1997 were analysed to determine more specific detailed customer requirements and were also used in a gap analysis.

The recommended next step after the gap analysis was to use the information on customer requirements to generate a new Nortel Networks supplier environmental assessment questionnaire that focuses on providing information for customer requests, ecodesign, PLCM, ISO 14001 continual improvement loops, ECMA declarations and meeting the requirements of the proposed WEEE Directive.

Research was conducted to determine the information requirements of ecodesign practices, current and pending legislation and continual improvement for ISO 14001.

The conclusions from programme one are that an improved supplier assessment process had to be developed in concurrence with a method for capturing detailed component material composition data from the supply chain and generating product material profiles.

5.0 Data Capture Solutions

A study was developed to compare the viability of a range of product environmental data sources including generic data provided in ecodesign software products. Details of the study can be seen in Chapter 6 of the thesis document and the research publications. The conclusion of the study was that only supplier-specific component-specific data from suppliers could meet the needs and data requirements outlined in programme 1 of the research project.

A data management system (Web-SEAP) was designed to capture data from the supply chain and to facilitate its communication to users within Nortel Networks. The infrastructure is presented in Figure E2.

Web-SEAP is an internet-enabled software solution that would allow suppliers to complete questionnaires and submit product material declarations on a Nortel Networks web server. An alpha version was developed using Active Server Page technology with a Filemaker Pro database. Details are provided in Chapter 6 of the thesis document.

It is feasible for the system for data collection to be integrated with current Nortel Networks component databases although further modification of existing systems would be required.

Methods for product material data validation have been investigated but further work is required in this area.

Perhaps the most manageable and cost-effective solution for product material data capture from the supply chain is an industry declaration collaborative approach. Three such approaches are currently undergoing development and this research has contributed to the EICTA supply chain management materials project that is one of the initiatives.

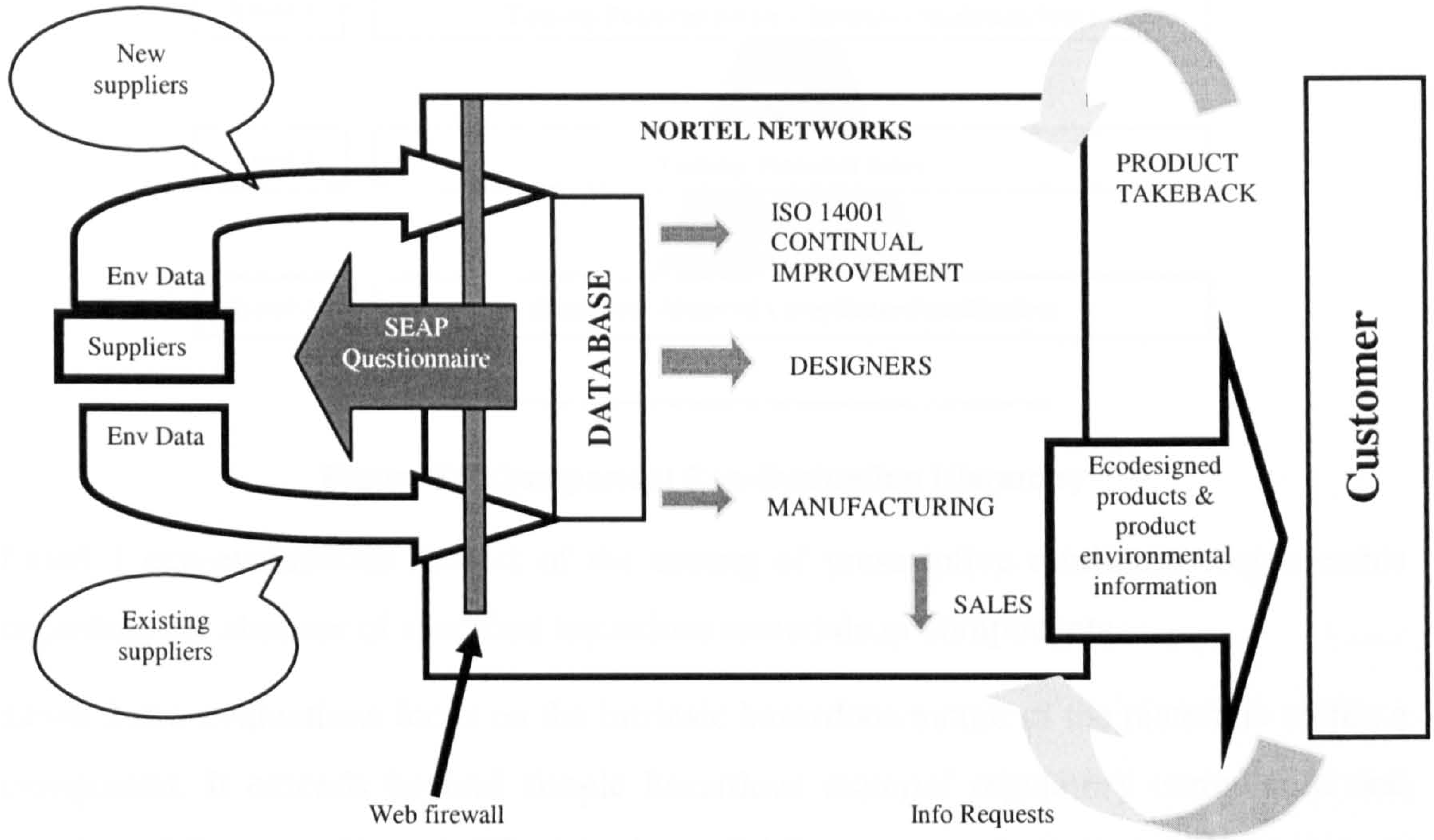


Figure E2. Product Environmental Information System

6.0 Data Utilisation

6.1 Component Eco-Evaluation Methodology

A methodology for the eco-evaluation of components from suppliers has been developed that is based upon the available and potentially available product-focused information from the supply chain. The objective is to evaluate the eco-performance of components from different suppliers as an integral element of the supplier and component qualification process. The method allows for the meeting of minimum requirements for qualification approval (regulatory compliance) and also for making more complex evaluations that incorporate the use of key environmental assessment factors and more information. The hierarchy of evaluation consists of four levels and the structure is shown in Figure E3. It is suggested that one or more levels are implemented depending on the perceived requirements of the company.

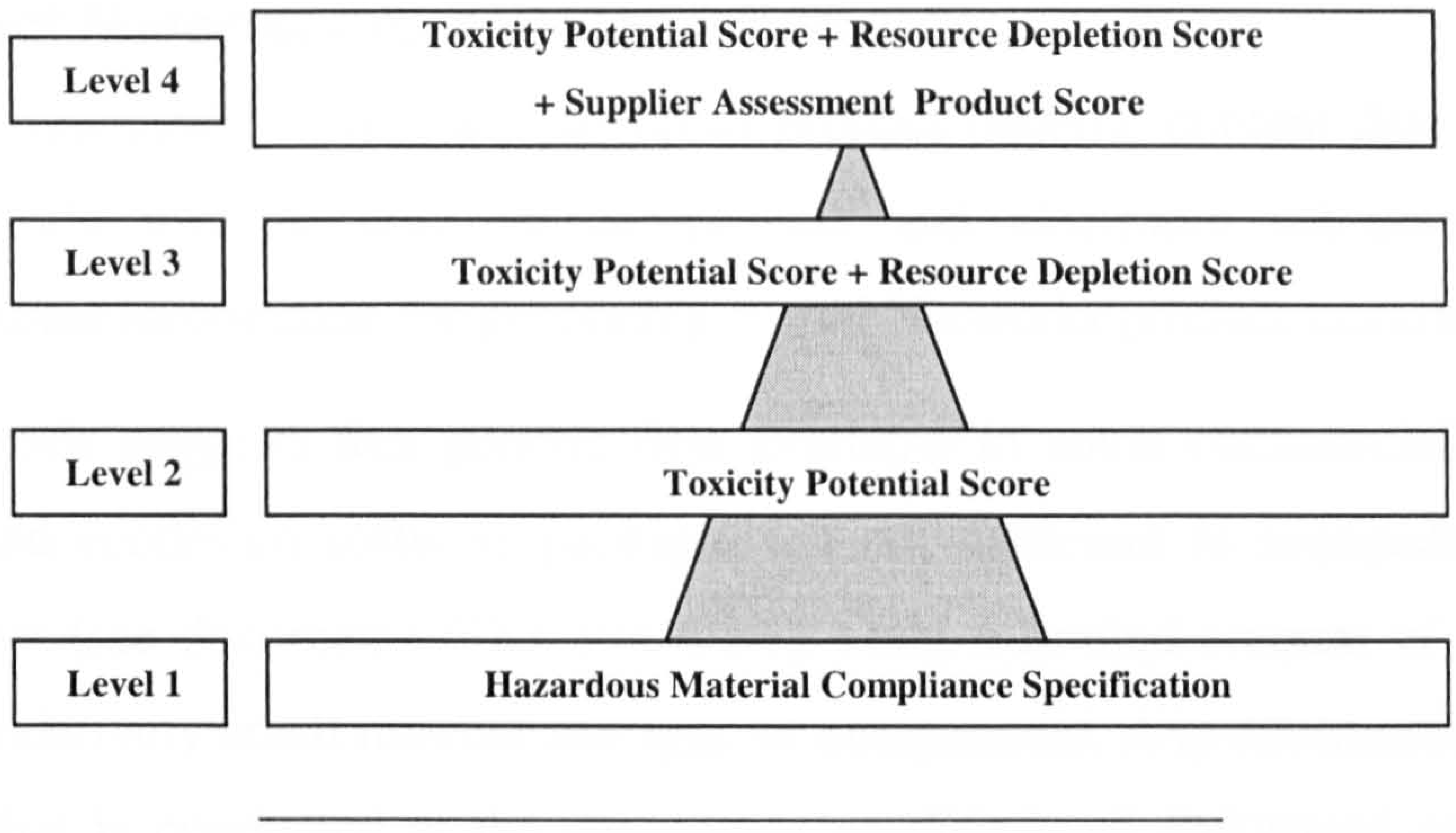


Figure E3. Component Eco-Evaluation Hierarchy

Level 1 eco-evaluations consist of the setting of prescriptive minimum requirements regarding the absence of specified hazardous materials in components.

Level 2 eco-evaluations focus on the intrinsic hazardous nature of the materials within a component. It extends beyond simple hazardous material regulatory compliance and consists of the generation of a Toxicity Potential Score.

Level 3 eco-evaluations incorporate the consideration of resource depletion into the selection process for suppliers of components as well as toxicity. The objective is to provide a decision framework for supplier selection and also to provide information for product end-of-life decision-making. The formation of a performance matrix allows dominance to be checked first. If one option out-performs all the others on both criteria it is clearly the preferred option. If dominance does not exist then the MCDA linear additive model is applied with the allocation of scales and weightings. The result is the identification of a preferred option.

Level 4 eco-evaluations consist of the parameters included in levels 1 to 3 and also consider the suppliers' commitment to product environmental improvement and information provision through the use of section B SEAP scores (see details in Chapter 6 of the thesis document). The methodology enables the evaluation to be broader in scope and to include consideration of such issues as commitment to ecodesign and the provision of hazardous material and LCA data. The principles of Level 4 Eco-evaluations are identical to Level 3. Dominance is considered first and then MCDA is used to generate a preferred option.

6.2 Product Material Profile Generation

The second hypothesis driving the pursuit of product material content data is that only supplier-specific material data on components and electronic sub-assemblies can provide accurate information for generating Nortel Networks product material profiles.

This hypothesis suggests that generic data available in some commercially available databases and ecodesign software packages are not sufficient to successfully achieve this objective (see documents C2.1 and C2.4). Only a limited amount of information exists on a relatively small number and type of components. Any environmental impact modelling that is conducted at the electronics product level and based on these data would be particularly restricted and the results potentially inaccurate and misleading.

The increasingly more demanding requirements of customers for product environmental information have been detailed in Chapter 5 of the thesis document. The general trend in network operators' supplier environmental assessments has been from management system related issues to hazardous material and total material content of products and product eco-performance in general. It is currently very difficult state accurately exactly which substances are present in a product without detailed information from the supply chain. The only other alternative is to attempt to generate some form of material profile using average or generic data.

Research was conducted to investigate the feasibility of collating component and sub-assembly material content information into a Nortel Networks product material profile, assuming the data were available. The research focused on three Nortel Networks products and the processes in place for managing and tracking product releases and bill of materials.

6.3 Data Utilisation Discussion

The eco-evaluation hierarchy from Levels 1 to 4 provides a tiered approach to implementation that reflects the type and quantity of data available and the objectives of the implementers. Data availability is fundamental to any eco-evaluation level.

Level 1 requires relatively little data to ensure regulatory compliance. Level 2 requires a declaration of hazardous material content. Levels 3 and 4 require a comprehensive product material declaration. Level 1 declarations are relatively simple to provide and negative declarations are, therefore, currently the preferred option for suppliers. Capturing comprehensive product material content data from component suppliers, is currently extremely difficult. Few suppliers have systems in place to provide this type of data. Only two suppliers included in the SEAP pilot study (detailed in Chapter 6 of the thesis document) were proactively investigating methods and systems to provide customers with detailed material data.

Another issue to recognise as a potential problem is the quality of data provided. It is imperative that suppliers also provide details of a transparent methodology that has been used to generate the material data content including any error and uncertainty considerations.

Since large errors and significant uncertainty in the data could completely negate the possibility of a meaningful and useable answer emerging from the eco-evaluation an accurate and standard methodology for measuring materials is a prerequisite. An examination of suitable measurement methods and a proposal for a data validation method were conducted as an MSc research project under supervision of the RE (details are provided in Chapter 6 of the thesis document).

Level 4 eco-evaluations use three criteria to assess components from suppliers. These criteria were selected in this work because of their generally recognised importance in terms of environmental impact in the electronics industry. The inclusion of other criteria in any eco-evaluation would require the capture of even more detailed data necessitating a mass balance or life cycle inventory approach and Form A1 (the product data capture element of SEAP (see Chapter 6 of the thesis document) has fields for the provision of information on hazardous materials used during manufacture.

The capturing of component material composition data allied with information on a supplier's environmental programmes allows an appraisal to be made. More detailed data would aid the decision-making process or at least make it more informed but capturing such data would be even more difficult and resource intensive (see Document C2.4). Basing decisions upon the criteria used in Level 4 eco-evaluations is considered a logical compromise that advances product life cycle management with a modicum of investment in data capture without demanding full life cycle inventory data.

In summary it is recommended that component eco-evaluation is integrated into the component or technology qualification process. Such evaluations are particularly suited to the new commodity introduction process, which forms a part of the product development process. In this context component and supplier product related eco-performance can become an established element of the decision-making process for supplier selection. Such a step could also initiate a drive towards the serious consideration of product eco-performance in the context of ISO 14001 continual improvement and a recognition of supply base environmental performance being a significant environmental aspect, with product eco-innovation and a focus on materials management, providing a vehicle for product-oriented continual improvement.

7.0 Contributions to Knowledge

The research conducted for this Doctorate has contributed to knowledge in the field of Product Life Cycle Management, and particularly Environmental Supply Chain Management.

Key contributions include:

- Identifying the data that need to be captured from suppliers to meet the requirements of legislation, customer requests for information, ecodesign of telecommunications products, and ISO 14001 continual improvement of product environmental management;
- The development and testing of a method to capture both management performance and product material data from the supply chain;
- The creation of a tool to evaluate the environmental performance of production related suppliers in the telecommunications industry; and
- The development of an environmental performance evaluation method for commodity qualification and purchasing decision-making.

Each of these contributions advance the field of Product Life Cycle Management and provide the telecommunications industry with knowledge and tools that can be used to improve environmental performance.

8.0 Professional Development Courses.

A requirement of the EngD programme is the satisfactory attendance and completion of all scheduled professional development courses and one additional elective course. All courses and associated assignments have been completed successfully. The assignments and performance scores are part of the portfolio for the examination process but are not published in the final document. They are located in Section C-3 of the portfolio.

All the skills gained from the taught courses have aided the completion of the research project. The project management, leadership, team-working and communication skills have been particularly useful. Subject areas covered in the taught modules include,

- Project Management;
- Leadership;
- Clean Technology;
- Sociology;
- Marketing;
- Business Finance;
- Media;
- Risk Assessment and Management;
- Environmental Auditing; and
- Environmental Law.

9.0 Conclusions

Throughout this Engineering Doctorate the focus has been on improving product environmental performance through improving existing Product Life Cycle Management practices. The research findings show that it is possible to implement mechanisms to capture supplier environmental data and to use these data in practical ecodesign, commodity selection decision-making, continual improvement for ISO 14001 and the generation of product material profiles.

It is recommended that the telecommunications industry implements a collaborative commodity material data capture system and uses the eco-evaluation tools developed in this research as a basis for including environmental criteria in component selection and purchasing decision-making. This will assist in complying with legislation, enable customers to make more informed decisions and foster the improvement in environmental performance of products throughout the supply chain. Such a situation can only be beneficial to the longevity of the planet.

Chapter 1 Introduction

The objectives of this chapter are to:

- Introduce the EngD (Engineering Doctorate);
- Summarise the portfolio structure;
- Introduce the research project; and
- Explain the thesis structure.

1.1 The Engineering Doctorate (EngD)

"An Engineering Doctorate is 4 year research degree, awarded for industrially relevant research, based in industry and supported by a programme of professional development courses" (EngD Handbook, 2000).

The EngD programme is financially supported by the Engineering and Physical Sciences Research Council (EPSRC). Ten universities are currently offering the EngD programme. The combined Surrey and Brunel University EngD programme has the distinct theme of Environmental Technology.

The aim of the Surrey/Brunel EngD is to

"...create graduate Research Engineers with the necessary background knowledge, skills and experiences to understand the relationship between the environment, technology and business and to apply this understanding to the development, promotion and execution of corporate strategy" (EngD Handbook 2000).

The EngD is designed to be as intellectually challenging as a PhD but, fundamentally, and in addition, provide the research engineer with fours years' experience of conducting research in an industrial context.

The EngD thesis is portfolio-based as opposed to dissertation-based (traditional PhD) which enables the examiner to obtain a much broader and in-depth view of the research project. In addition the research engineer is also required to attend and pass a range of Masters degree-grade professional development courses (see section C-3 of the portfolio).

1.2 Portfolio Structure

Because of the portfolio structure of the EngD it is necessary to explain the optimal approach for reading and understanding the portfolio.

The portfolio consists of the following three core elements:

A. The Executive Summary
B. The EngD Thesis (the final six-month report)
C. Other Portfolio Documents

C-1	Six Month Reports
C-2	Research Publications
C-3	Module Assignments
C-4	Support Documents

1.2.1 The Executive Summary - A1

The executive summary provides a summary of the work undertaken in the research project. It describes the scope, objectives, the programme of work, the results and the contribution to knowledge.

1.2.2 The EngD Thesis – B1

The EngD thesis is a document structured in the same way as a typical or classic PhD thesis and serves as the final six-month report. It is this document that provides the detail of the research project and presents the core thesis of the research. Other documents in the portfolio such as research publications and support documents are referenced in the thesis.

1.2.3 Six Monthly Reports C - 1

The six-month reports serve as a record of progress throughout the research project. They follow the same format and present a regular appraisal and review of work achieved in each six-month period. They are not intended to constitute the doctoral thesis.

1.2.4 Research Publications C - 2

This element of the portfolio contains published research material that the RE has authored or co-authored. The published work supports the claims for contribution to knowledge and are referenced throughout the EngD Thesis (B-1)

1.2.5 Module Assignments C - 3

The module assignments and assessed scores are provided to demonstrate the RE's participation, completion and passing of all the professional development courses that are scheduled in the EngD programme. This is a requirement of the EngD.

1.2.6 Support Documents C - 4

The documents in this section are all the additional documents that the RE wishes to include in the portfolio as relevant documentation that supports the EngD.

1.3 The Research Project and Nortel Networks

1.3.1 Research Project

The aim of the research project is to contribute to improvements in the environmental performance of Nortel Networks products through the development of product environmental information management systems and decision-making methodologies for component selection (as agreed by Nortel Networks and Brunel University).

The core objective is to investigate the feasibility of integrating supplier-specific, product-specific environmental data into the ecodesign process and the Nortel Networks Product Life Cycle Management (PLCM) system. The project is one component of a response of Nortel Networks to the increasing need for improved environmental performance of products and company activities. The need for improved product environmental performance in the telecommunications industry and the integration of "green" design practices (ecodesign/DfE) into the product development process are driven by three key pressures:

- customer requests for eco-friendly products and the inclusion of environmental criteria in customer supplier selection processes;
- legislative requirements; and
- ISO 14001 requirements.

The research project involved the investigation and development of methods and tools to meet the information and product environmental performance requirements of customers of Nortel Networks, legislation and ISO 14001 and consequently to improve product environmental performance.

The project reflects the interest and need within the telecommunications industry to integrate supply chain performance criteria into product development and ecodesign processes. The issues are complex and the topic area particularly in-vogue at the present time as the structure of electronics manufacturers' supply chains has changed to one of predominantly contract manufacture. In addition, European legislation and customer requests for product environmental information are becoming ever more stringent and comprehensive.

The initial scope of the project focused only on component and or product evaluation but it was evident early in the project that a strategy for any environmental evaluation of the supply chain needed to be researched and recommendations made.

1.3.2 Nortel Networks

Nortel Networks is a global telecommunications company providing network solutions and equipment with increasing emphasis on optical technology. The company is a leader in the provision of equipment for the communication of voice, data and video, delivering networking and communications services and infrastructure for customers in more than 150 countries. The driving force of the company is the development of new technologies for communication in thirty-one technology centres around the globe.

Headquartered in Brampton, Ontario, Canada, Nortel Networks have been in operation for over one hundred years. Nortel Networks has a history of innovation not only in new technologies for communication but also in improving the environmental performance of the company and its products and services. Active environmental research programmes are ongoing throughout the company. A more detailed introduction to Nortel Networks and its environmental programmes is provided in Chapter 2.

1.4 Thesis Structure

The Thesis document (B-1) is similar in structure to the traditional PhD thesis dissertation. It is not intended to replace the portfolio but rather to compliment it and provide a concise summary of the work undertaken. It presents the research in a clear and concise format that presents the method of research and can be regarded as the final six-month report.

The thesis contains nine chapters:

1. Introduction
2. An Introduction to Nortel Networks and Telecommunications
3. The Research Programme (Methodology)
4. Background to the Research Programme (Literature Review)
5. Data Requirements
6. Data Capture Solutions
7. Data Utilisation
8. Discussion
9. Conclusions and Further Work

Chapter 1 provides an introduction to the EngD, explains the portfolio structure, and introduces the research project and the sponsoring company, Nortel Networks. Chapter 2 is an overview of telecommunications, Nortel Networks and the environmental research programmes that have been implemented and the existing process for supplier and commodity assessment. It provides the industrial context for the research. Chapter 3 introduces the research aims and objectives of the research programme and an outline of the research framework and methodology used in conducting the research. In Chapter 4 the background to the project is presented. This is an overview of work conducted in the field of research that provides a context for the research project. It demonstrates the Research Engineer's awareness and understanding of the field of study, research previously conducted, and provides a context for the RE's contribution to knowledge.

The research project consisted of three cores areas or programmes of work. Chapters 5, 6 and 7 are devoted to each of the areas respectively. In each chapter the research is described and results presented. Chapter 5 details the information that needs to be obtained from suppliers to meet the requirements of ecodesign, legislation, customer requests and ISO 14001. Chapter 6 presents the research conducted on methods of data capture from the supply chain and the recommendations generated. Chapter 7 describes the research conducted to examine how supplier component material data and company environmental performance data can be used in terms of supplier selection and component selection decision-making; in the generation of product material profiles for complex telecommunication products; and in meeting the requirements of legislation and ISO 14001.

Chapter 8 provides a discussion of the key findings from the research and the identified contributions to knowledge including critical review. Chapter 9 concludes the research project with claims and recommendations that have emerged for the work. Suggestions for further research work that would expand upon the research project findings are offered.

Chapter 2 Nortel Networks, Telecommunications and the Environment

The objectives of this chapter are:

- To introduce telecommunications;
- To provide an overview of the business structure of Nortel Networks;
- To discuss the environment programmes of Nortel Networks; and
- To present the current process for supplier and component evaluation.

2.1 An Introduction to Telecommunications

Telecommunications has come a long way since the invention of the telegraph in 1840 and the telephone in 1876. From an analogue wire-line network designed to transmit speech, telecommunications has now become the transmission of data, video and voice over global networks which are a combination of wire-line, wireless and optical infrastructures.

The past decade has seen a revolution in both the information technology and telecommunications industries with the growth in personal computer ownership, and the explosive growth of Internet and e-mail use, cable and satellite television subscriptions and the use of mobile telephones. This has resulted in an increasing demand for telecommunications products and services and increasing investment in new technology.

The huge increase in demand for telecommunication equipment means that Nortel Networks have expanded and grown significantly since the 1980s. From a strong North American-based provider of digital switching and routing equipment Nortel Networks has now become a global leader in telephony, data, wireless and wire-line solutions for the Internet. The company considers itself to be at the heart of the Internet revolution and is committed to providing faster and more reliable communication solutions. Being a global company Nortel Networks is in a strong position to benefit from the global demand for Internet-based communications and can drive the realisation of the "global village".

To be a leader in the telecommunications market though Nortel Networks has had to form strong partnerships with, or even acquire, young companies with specialist knowledge in developing new products and markets. Nortel Networks exists as a company because of the merger between Nortel and Bay Networks in 1998. The company has had to radically change its structure to remain competitive in the emerging networks market. This re-structuring has resulted in the organisation out-sourcing the manufacture of equipment to contract electronics manufacturing organisations. This enables Nortel Networks to focus on customer-facing functions and the research and development of core technologies.

Despite the overall growth in the use and development of Internet products and services the volatility and dynamism of the global telecommunications market has been demonstrated with a down turn in the industry through 2001 and 2002. The explosive growth of investment in the Internet ($4000bn spent on telecommunications equipment in Europe and the US between 1997 and 2001 – source FT.com) mainly through the building of networks with enormous bandwidth capacity has recently proved to be a core issue. The expected demand for bandwidth has not materialised and the result is over-capacity in existing networks and consequently, a halt in the purchasing of new equipment. Coupled to this is the emergence onto the market of a vast quantity of equipment from bankrupt start-up companies. Nortel Networks is just one of many telecommunications companies that has had to rationalise its workforce, write off some of its biggest losses in history and re-focus on its core competencies. According to Waters (2001):

> "The technological change that led to the emergence of the Internet, along with global deregulation, seemed to offer a promise of huge growth ahead. The prospect of much higher revenue growth rates in turn encouraged telecoms companies to construct financial models that included far larger slugs of debt. Those assumptions have proved fallible on two counts. One is that they didn't adequately take account of the effects of competition. The other mistake was to assume that growth rates in the telecoms industry were moving to a permanently higher level. In fact last year's dotcom collapse had a much more far-reaching effect than seemed likely at the time as the financial markets cut off the supply of cash to the telecoms and technology industries".

For Nortel Networks and the telecommunications industry the coming years are likely to be a period of consolidation followed by a period of slower growth. The industry will maintain its vision of increasing demand for bandwidth through broadband that will provide the carrying capacity for ever more sophisticated communications services such as third generation mobile which brings the Internet to mobile phones and video conferencing which one day may replace the audio telephone.

Internet technology is still considered to be the future of global telecommunications networks.

2.2 The Business Structure of Nortel Networks

The top-level business structure of Nortel Networks is relatively simple and exists in two forms. However, the structure and interaction between business groups below the top level becomes more complex. The first structural element is "Line of Business" (LOB) or business function, the second is geographical. Through both elements Nortel Networks manages all its business operations, activities and products on a global scale.

The organisation serves the emerging and existing needs of service providers, carriers, dot-com companies, small and medium sized businesses, and large corporations in more than 150 countries and territories around the world. All customers are businesses. Typical examples are any major telecommunications service provider such as British Telecom or Cable and Wireless. It has operations in Canada, Europe, Asia, Caribbean and Latin America, the Middle East, Africa and the United States.

Key competitors include Siemens, Lucent and CISCO Systems.

2.2.1 Lines of Business

The number and the definition of the Nortel Networks LOBs are subject to constant change in response to technology developments and the response of Nortel Networks to the market. Currently there are three core LOBs, two of which can be divided into further business functions :

- Service Provider and Core Networks
    - Core Internet Protocol Networks;
    - Enterprise Solutions;
    - Metropolitan Optical;
    - Wireless and Core Networks
- Optical Internet

- High Performance Optical Component Solutions
  - High Capacity Optical Solutions
  - Optical Networks
- eBusiness Solutions

A range of products are offered across all of the business functions to meet the market need of the customer. Product types range from a desktop business telephone to a complete architecture and infrastructure for a global network.

The product family names are listed below:

- **Alteon**
- **BayStack**
- **Business Series**
- **CallPilot**
- **Centillion**
- **Companion**
- **Contivity**
- **CVX**
- **DMS**
- **Meridian**
- **Norstar**
- **OPTera**
- **Optivity**
- **Passport**
- **Periphonics**
- **Preside**
- **Shasta**
- **Succession**
- **Symposium**
- **Univity**

Each family contains a range of electronic telecommunication products. The vast majority are exchange, node or switching equipment designed to transfer voice, data and video either digitally or optically along thousands of miles of cable or optical fibre.

In addition to the three core LOBs there are other business functions that serve each such as Global Operations, which includes functions such as Technology, Supply Management and Global Customer Services. These are divided according to geographical location.

2.2.2 Geographical Organisation

- Asia

- Americas
- Europe, Middle East and Africa

The division of the organisation into business functions enables clear focus on the requirements of specific markets, regulatory processes and competitor activities.

2.3 Nortel Networks Environment Programmes

Throughout the last decade environmental issues have become more significant and important to most large companies. This could be attributed, indirectly, to an increased societal awareness of the environment and possibly to the importance placed on the findings and recommendations of the 1992 Rio Earth Summit by governments and organisations globally.

Directly, environmental issues have become more significant because of increasingly more stringent legislation, customer requirements, competitor pressure, the implementation of Environmental Management Systems and the development of the fields of ecodesign and life cycle assessment. In fact, from the Nortel Networks point of view, the sequential order of these factors reflects the degree of significance attributed to them. They have resulted in companies changing the way they do business by attempting to integrate environmental performance considerations with standard business practices. This results in a move away from the perception of environmental issues being solely compliance issues and towards a more proactive approach with environmental improvement as a business opportunity. This is particularly evident with the now widespread adoption of the environmental management system standard ISO 14001 with a commitment to continual improvement. In many industries and notably in the electronics industry, ISO 14001 certification is becoming a licence to do business as customers specify it as a requirement through the supply chain.

It can be argued though, that legislation still has the most dominant influence on an organisation's actions to improve environmental performance. In the past four years key legislation has been drafted at a European level which, when finalised, will result in a dramatic impact on the electronics industry. The principle of product stewardship and life cycle thinking is embedded in the objectives of the WEEE (Waste from Electrical and Electronic Equipment) and the RoHS (Restriction on the Use of Certain Hazardous Substances) Directives, which principally aim to reduce electronics waste and phase out the use of certain hazardous materials respectively. Both the WEEE and the RoHS

Directives will impact all Nortel Networks products. Further details on the WEEE, RoHS and EUP Directives are provided in chapters four and five.

Nortel Networks is "committed to being a leader in the telecommunication industry in protecting and enhancing the environment. Wherever Nortel Networks does business, it will take the initiative to develop innovative solutions to environmental issues that may arise because of its products, operations and business activities" (Nortel Networks, 1996).

The organisation has maintained a proactive approach to improving environmental performance since the mid 1980s when it first introduced an environmental audit programme. Since the establishment of a Corporate Environment function in 1987 a number of programmes have been initiated either directly by the corporate group or indirectly by technology functions.

Examples of some of the innovative programmes initiated include:

- The elimination of ozone depleting substances from manufacturing operations in 1992;
- The generation of guidelines and a commitment to PERI (Public Environmental Performance Initiative) in 1993;
- The setting of four corporate core environmental performance targets in 1994 (with a base line of 1993) to be met by 2000:
- A continued growth in the number of sites with environmental management systems accredited to ISO 14001 (21 in 2001 and a proposed corporate certification);
- The successful development and test of the world's first lead-free telephone;
- The development, patent and use in products of a molybdenum phosphate corrosion protection and EMC shielding coating to eliminate the use of chromate in certain applications; and
- Research programmes on the development and implementation of ecodesign and life cycle assessment.

The four environmental performance targets set in 1994 provided a real focus for each local site to contribute to a global objective. The four targets were:

- **Energy Efficiency**: Improve overall energy efficiency by 10% by 2000;

- **Pollution Prevention:** Reduce total pollutant releases (air, water, hazardous wastes) to the environment by 50% by 2000;
- **Resource Conservation:** Reduce paper purchases by 30% by 2000;
- **Waste Minimisation:** Reduce all solid non-hazardous waste sent for disposal by 50% by 2000.

Since 1993 the organisation has reported its performance against these targets and also its performance for other significant impacts such as greenhouse effect and water consumption. All reporting data are collated in an environmental management system information management software tool, verified by a third party and the performance publicly reported in an annual environmental report. In 2000, the final results were released and the company had met two of the targets (energy efficiency and resource conservation). However the targets were set in absolute terms without consideration given to the impact of company growth on meeting the targets. When the performance is normalised against cost-of-sales it is evident that Nortel Networks have significantly improved their environmental performance since 1993 (see Figure 1).

In addition to the corporate targets each individual Nortel Networks site will have its own targets to meet in terms of continual improvement. From 2000 onwards no corporate targets are planned but each site will continue to develop their own targets for continual improvement.

Nortel Networks has a wealth of experience in implementing environmental management systems and related activities but also since 1993 there has been a steady and increasing emphasis on product-related environmental issues. This is partly due to legislation, ISO 14001 and customer interest and requirements but also due to a largely proactive approach by Nortel Networks to research on environmental performance improvement topics. Both Francis (1998) and Poyner (1997) demonstrated how product focused academic research could contribute to the generation and development of solutions and tools for continued product environmental performance improvement within Nortel Networks and further the fields of Life Cycle Assessment and Design for Environment. The research described in this thesis adds to this body of knowledge and primarily contributes to ecodesign and product life cycle management initiatives.

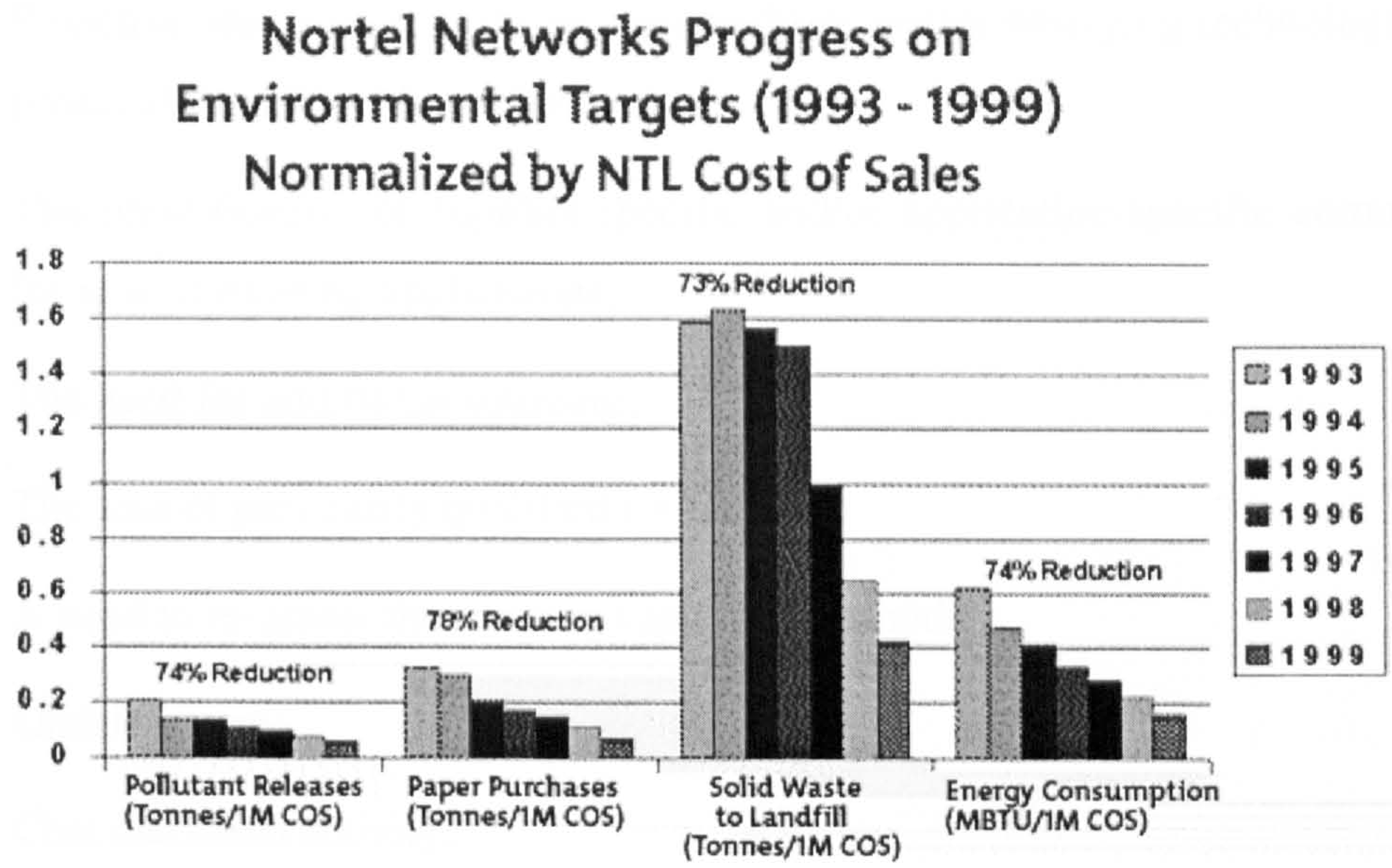


Figure 1 (Source – Nortel Networks, 2001)

Initiatives on product environmental performance improvement form part of the Nortel Networks corporate strategy on product life cycle management, to add value to its product portfolio and the services offered and to ensure it stays "one step ahead of legislation and protecting the environment" (Nortel Networks, 2001). Within this framework new opportunities are identified for continual improvement. Initiatives may be implemented and conducted either directly by the corporate Environment and Well-Being group or through the technology functions.

Environmental strategy at Nortel Networks is dynamic. It evolves and responds to various pressures such as legislation, standards and customers. As the telecommunications market becomes increasingly more dynamic and competitive and new legislation is implemented over the next fives years the environmental strategy of Nortel Networks is likely to change dramatically.

2.4 The Supplier and Component Qualification Process

Component/supplier qualification is the first step in a process of approving components from specific suppliers for intended use in the designs and resulting products of Nortel Networks. The qualification process may be initiated by the following (Nortel Networks, 1999 a):

- Component selection resulting from new designs;
- Design enhancement projects on existing Nortel Networks products;

- Proactive identification of new commodities and/or emerging technologies with potential for use in Nortel Networks;
- The identification of supplier-specific and/or application-specific commodities for new or existing applications;
- The need for additional sourcing;
- The loss of previously qualified sources;
- A need to re-assess the existing supplier/commodity;
- Obsolescence;
- Cost reduction activity;
- Third party design capture; and
- Integration of acquired companies into Nortel Networks.

Within Nortel Networks, the component/commodity qualification is controlled by a Supplier and Parts Management Corporate Standard (Nortel Networks, 1999b) and associated standards. The standard details a generic process to assess the capability, to qualify and certify suppliers of commodities for use in products manufactured or distributed by Nortel Networks and its subsidiaries and an operating method that combines several Nortel Networks organisational groups and their expertise (Supply Management, Procurement, Component Engineering, Procurement Engineering, Product Assurance and Component Engineering) into a comprehensive team to manage:

- supplier capability assessment and qualification;

- a globally integrated supplier audit programme.

The team is called the Portfolio Technology Management Team (PTMT) and its main responsibilities are;

- Supplier selection;
- Supplier strategy;
- Monitoring contract performance;
- Monitoring new technology opportunities;
- Review and resolution of quality issues;

- Initiation of qualification activities/monitoring supplier performance and processes; and
- Maintenance of audit schedule.

For new Nortel Networks product development projects an additional process is followed to "facilitate selection and use of the best components and suppliers to support development and maintenance of cost effective and environmentally responsible products that are robust, reliable and manufacturable"(Nortel Networks, 1995). This requires the nomination of a component management prime for the project and the formation of a component management team. The team ensures that the objectives of the process are achieved through a selection of tools and methods that include a project component acceptance strategy (including component technology, packaging, test, supply and manufacturing strategies, high risk component strategies as well as components impacting customer safety and regulatory requirements and determining the need for alternate suppliers) and the generation of key item lists, component coding and qualification. The project component management team communicates and interacts closely with the PTMT.

All suppliers of Nortel Networks supplying a component or commodity are subjected to the supplier and component qualification process to meet the requirements of Nortel Networks. In addition to qualification, suppliers are categorised further according to their level of business and technical performance. Once qualified, a supplier can become an approved VMR (Value Managed Relationship) supplier. A VMR supplier has preferred sourcing status and a close working relationship with Nortel Networks. Approved preferred and approved VMR suppliers are given the first opportunity to supply any new component, part or commodity. Thus, this categorisation practice has a dominant affect on the selection process. Categorisation of suppliers will be discussed in section 2.4.6.

The organisational responsibilities in the current qualification process are provided in Table 1. The Design Prime has overall responsibility for the component management team.

Table 1.
Nortel Networks Organisational Responsibilities in the Qualification Process

Function	Responsibilities
Design Prime	Provides technical information to facilitate the generation of the Controlling Document Ensures that only commodities meeting end product requirements, and capable of being approved, are selected Ensures that selected commodities go through the Commodity Introduction process (per CS 168.00) Ensures that Controlling Documents specify design and application - specific requirements where necessary Ensures commodity meets application-specific reliability requirements (Reference CS 180.40) Ensures that commodities are selected from approved Nortel suppliers. Design Prime or authorized delegate ensures that alternate source commodity is acceptable in the application.
Nortel System House Purchasing	Supports the Commodity Introduction process (per CS168.00) Provides supplier performance data Purchases approved commodities De-risks supply issues Ensures that commodities have multiple acceptable suppliers, whenever possible, per Nortel Networks Supply Strategies and design needs
Nortel Supply Management	Assesses business viability of suppliers (Reference CS 180.50) Defines Nortel Networks Global Supply Strategies through the PTMT Team Monitors supplier performance and provides feedback to CPP Negotiates Nortel Networks supply agreements and contracts for commodities
Nortel System House Component Material Engineering	Ensures that the manufactured Nortel Networks product contains only qualified commodities Monitors supplier quality performance and provides supplier support Provides feedback to CPP and Nortel Supply Management and PTMT on the quality performance of suppliers Coordinates local application-specific (Q3) and facilitates qualification activities (Q2) Generates and maintains local Controlling Documents where required Co-ordinate PCN activities in Nortel System House. Ensure new additional sources are acceptable in application.
Commodity Portfolio Prime	Provides early design guidance in the selection of commodities, technologies and suppliers Monitors and informs key Nortel personnel of future commodity, supplier and technology trends Assists design prime to review application-specific reliability requirements of commodity where applicable Introduces new commodities and suppliers to the Corporate Database Issue/identify Controlling Documents Assesses commodity compliance to the Controlling Documents Makes the qualification decision and records it on the Corporate Database Assesses the capability, quality, integrity, and potential risk of commodities and suppliers Co-ordinate and facilitate the audit program with other Nortel Network's System Houses Assesses supplier process changes and last-time-buy notices, and follows CS180.63 Maintains key commodity information on the Corporate Databases

The generic supplier and parts management process consists of three core aspects of qualification:

- Supplier assessment (Q1), as covered in CS180.50 (Nortel Networks, 1999c)
    - Business assessment (Q1b)
    - Technical capability assessment (Q1c)
- Commodity quality and integrity assessment (Q2), as covered in CS180.60 (Nortel Networks, 1999a)
    - Generic technology (Q2t)
    - Commodity/part specific requirements (Q2p)
- Application specific assessment (Q3), as covered in CS180.60 (Nortel Networks 1999a).

2.4.1 Supplier Assessment

Supplier assessment consists of two core activities:

- Business assessment (Q1b)
- Technical capability assessment (Q1c)

The combined result of the two activities is a supplier qualification status. This status is recorded in the component database and is applied to a company or corporation as a whole, regardless of the number and location of its operations, or the commodities provided by the supplier.

2.4.1.1 Business Assessment

Business assessment requires the following considerations to be addressed by the Supplier Auditing and Qualification Team.

2.4.1.1.1 Business Stability

The supplier's financial position shall be measured as per Nortel Networks Procedure 712.09, which includes an assessment of a recent financial statement by a qualified Nortel Networks financial analyst, a review of payment history, debt structure, liens or judgements.

2.4.1.1.2 Security of Supply

The supplier shall have adequate capacity and commitment to supply the commodity throughout the product life cycle.

2.4.1.1.3 Conflict of Business Interest

Business conflict (competition) to Nortel Networks shall be identified. Conflict of interest with any person that would bring any future relationship into question shall not exist.

2.4.1.1.4 Product Diversification

The supplier should have diversification in a product environment (e.g. multiple products in multiple markets to ensure steady growth and minimal risk of business failure).

2.4.1.1.5 Global Supply Strategy

The supplier should have the ability to be a global supplier to Nortel Networks, including a willingness to provide unified pricing, contracts, distribution, and support.

2.4.1.1.6 Nortel Networks Business Level

The level of Nortel Networks business relative to the supplier's overall business level should not exceed industry norms (15 - 30% maximum). VMR suppliers may be exempt of this requirement if the PTMT agrees to a higher level.

2.4.1.1.7 Compatible Policies

The supplier should have company policies, objectives and ethics compatible to Nortel Networks.

2.4.1.1.8 Other Requirements

When applicable, the supplier should be consistent with supply requirements covered by legislation (e.g. minority owned, local content) and customer contractual requirements (e.g. trade offsets).

2.4.1.2 Technical Capability Assessment

Nortel Networks prefers to conduct business with suppliers that have the following technical attributes listed in section 2.4.1.2.1 to 2.4.1.2.6 inclusive. The Supplier Auditing and Qualification Team are responsible for ensuring suppliers have the specified technical attributes through the technical capability assessment. The focus of the technical considerations is on the supplier processes and practices.

2.4.1.2.1 Quality Systems

The supplier shall have, on commodities where applicable, a detailed and complete plan for Total Quality Management, including Statistical Process Control, continuous improvement, training, root cause analysis, failure mode and effects analysis, yield, customer complaint process, management and control of his supply chain, outgoing quality and any other relevant process.

If the supplier has a recognized ISO 9000 certification or equivalent, this shall constitute an approved and acceptable quality system. In cases where this is not so, the Corporate Standard 180.61 questionnaire (Nortel Networks, 1995) shall form the basis for this assessment towards qualification.

2.4.1.2.2 Technology

The Supplier shall have processes, which are compatible with the technology and commodity requirements of Nortel Networks. The Supplier should also demonstrate efforts made in continuous improvements of existing and new technologies.

2.4.1.2.3 Research and Development Programme Alignment

The R&D projects underway and planned for the future, should complement a successful Nortel Networks/supplier relationship, ideally parallel to Nortel Networks efforts for technology, quality and cost improvements.

The supplier shall be able to demonstrate to Nortel Networks their product and/or technology roadmap of their current and future offerings.

2.4.1.2.4 Documented Processes for Part Design and Manufacture

The supplier shall fully document the processes and procedures used. The qualification team will confirm this while actual audits will be performed during the qualification activities. Corporate Standard 180.40 (Nortel Networks, 1999b), defines typical requirements. Satisfactory completion of the Corporate Standard 180.52 (Nortel Networks, 1994) questionnaire is also required for granting a supplier approved status.

If a third party (subcontractor to Nortel's supplier) performs any part of the design or manufacturing processes, the following activities must be undertaken by the Qualification Team to assess the acceptability of the process used:

- Review the control, procurement and acceptance practices of the subcontracted process and the parts resulting from this process.
- Review the supplier's auditing and qualification process used with the subcontractor.
- Assist in the supplier's subcontractor audit activities as required, which are to be lead by the supplier. Any corrective actions logged against the subcontractor by the supplier shall be included or referenced in the Nortel audit report of the supplier.

2.4.1.2.5 Environmental Programmes

The supplier shall fully comply with all applicable environmental regulations. The supplier will continuously reduce the impact of its operations and products on the environment by reducing emissions and waste, by the use of post-consumer materials, by product stewardship, and by other means as necessary. Compliance to ISO 14001 and/or Corporate Standard 180.65 (Nortel Networks, 1995) is beneficial to demonstrate the good will of a supplier towards environmental issues.

2.4.1.2.6 Technical Ability

The supplier must have the technical processes and engineering in place to be able to demonstrate consistency in the capability of meeting all the requirements of the General Controlling Document, detailed specifications or supplier documentation. Part of this assessment is a supplier audit to Corporate Standard 180.52 (Nortel Networks, 1994) on reliability processes. The qualification team and/or the PTMT, prior to the assessment, determine the remainder of the technical assessment required.

2.4.1.3 Qualification Status

Suppliers that have been assessed against the requirements described in the previous two sections (part one of the qualification process) and have been validated using a specified audit process are then granted a supplier qualification status that combines possible results for both the business and technical aspects of the assessment.

The statuses are:

A - The supplier meets the business and/or technical capability criteria;

D - The supplier does not meet or no longer meets the business or capability criteria of Nortel Networks;

N - The supplier has been identified, but either no action has been taken to assess business and capability issues, or the action is to be completed by the date given on the corporate database.

W - The supplier qualification activity is complete. Corrective actions have been identified and are pending completion. Status will revert back to "N" status if there is no follow up within one year.

2.4.2 Commodity Quality and Integrity Assessment

The objective of the commodity quality and integrity assessment process is to assess commodity families and/or technologies to meet the specified criteria for quality/integrity and subsequently introduce them into Nortel Networks products. The process also results in the assignment of the appropriate supplier–part status.

2.4.2.1 Technology Assessment

The first step in the commodity assessment process is an evaluation of the generic technology associated with a commodity. This evaluation allows all those newly introduced commodities that use the same technology to be automatically allocated an appropriate qualification status without the need for direct evaluation. An example is the printed circuit board commodity where many individual boards with unique part and engineering numbers will use the same technology e.g. six-layer boards.

It is the responsibility of the technical engineer (the commodity portfolio prime) to determine the technology status of the respective commodity. The technology may be developing, mature or proven. The commodity portfolio prime evaluates the integrity of a technology provided by a supplier in conjunction with the capability assessment (see section 2.4.1.2). This allows a decision to be made regarding possible extension of a qualification status by similarity to any new commodity of the same type, from the same supplier.

Qualification by similarity can also be achieved by satisfying all or some of the following criteria:

- Similar technology;
- Manufacturer is the same for both commodities;

- Manufactured at the same site/sub-contractor;
- Manufacturing processes are similar;
- Manufactured using the same approved materials for the commodity and using the same process materials;
- Designed by the same manufacturer; and
- Similar performance characteristic of the part, component or commodity.

2.4.2.2 Commodity Introduction

All new commodities undergo the same procedure for introduction into the product development or manufacturing cycle of the company (for new projects this process may also form part of the new product introduction process). The procedure is initiated by a component request being made to the engineering prime for the commodity. This prime will then review the request against a range of criteria if an appropriate level of information has been provided. Some form of a controlling document would be considered an appropriate level of information. The controlling document captures the fit, form, function, quality and integrity of the commodity. The controlling document could be a Nortel Procurement Specification, a corporate standard, specifications unique to a system house, drawings, circuit diagrams or schematics or industry standards. The consideration criteria are:

- commercial off-the-shelf versus custom commodity;
- proven or emerging technology;
- commercial life expectancy;
- consistency with Nortel Networks Global Supplier Strategies;
- technical preference;
- safety/regulatory requirements;
- performance/application requirements;
- quality and integrity of commodity;
- component rationalization;
- end market customer requirements;

- availability (e.g. obsolescent technology, declining supply base, etc.);
- suppliers/sourcing;
- reliability standards/requirements;
- cost (price and/or total cost);
- sensitivity of the application;
- electrical and/or mechanical parameters; and
- manufacturability.

Commercial off-the-shelf supplier parts with proven technologies from approved suppliers will not undergo rigorous evaluation as it is considered unnecessary but will be allocated automatically either an A or D qualification status based primarily upon qualification by similarity (see Table 2). Commercial off the shelf supplier parts with emerging technologies will undergo thorough qualification and will normally be allocated E or F status.

The engineering prime's decision to qualify also takes into account the supplier assessment procedure including the capability assessment, the supplier audit and issues such as product tests and reviews which are all part of the overall qualification plan.

The supplier-part qualification indicators and definitions are provided in Table 2.

Table 2. Supplier Part Qualification Indicators and Definitions

Indicator	Definition for part qualification (Q2)	How used
A	**The 'supplier-part' meets the requirements for quality and integrity, as indicated in the controlling document, for the Product Level identified, if applicable.**	
H	**- Part pending initial application verification. - Controlling document may not be released.**	**- Used for Nortel 'custom' commodities** - Not used for COTS commodities.
E	**- Testing is underway for verification of quality and integrity. - High confidence for use. - Controlling document not complete.**	- Used for the introduction of 'emerging' technologies.- Not used for COTS/proven commodities.
D	**- The 'supplier-part' does not meet the requirements for quality and integrity as indicated in the controlling document, for the Product Level identified, if applicable.**	
N	**- No assessment activity has commenced or, - Assessment has commenced with a completion date identified on the corporate database.**	**- This indicator will be used for COTS/emerging technology, but** - Not used for COTS/proven technology.

F	**- A field replaceable part for a configurable OEM system meets the requirements for quality and integrity, as indicated in the controlling document, for the Product Level indicated, if applicable.** E.g.. fans in an OEM system	
X	**- 'Supplier-part' no longer available; typically has been discontinued.**	
V	**- Supplier-part specified for use in non-Nortel Networks developed design (third party design, acquisition, JV, etc.).**	

2.4.3 Application Specific Assessment

Custom components (application specific) are subject to further evaluation particularly in terms of reliability in a given application and it requires comprehensive input from the design authority. Application-specific reliability is defined as the ability of the part to function within given performance limits under specific conditions over a specific length of time, and may be assessed through physics-of-failure reliability evaluation and through application specific testing.

Application specific assessments result in the allocation of an application specific qualification indicator that is entered in the component database. This indicator will supersede the H indicator initially given in the commodity quality and integrity assessment. The indicator allocated automatically triggers the same indicator for supplier part qualification. Indicators and definitions are provided in Table 3.

Table 3. Application Specific Qualification Indicator Definitions

Indicator	Qualification definition	How used
A	**The 'supplier-part' meets the INITIAL application-specific requirements, as indicated by the design authority.**	**- Only used for 'custom' commodities. - Initiated by 'H' Part Qualification Indicator (Q2)**
T	**The 'supplier-part' is in process of application-specific testing by design authority.**	**- Only used for 'custom' commodities - Not used for COTS**
D	**The 'supplier-part' does not meet the initial application-specific requirements as indicated by the design authority.**	

2.4.4 Overall Indicators

An overall indicator is also generated for each supplier part that integrates all the elements of the Parts Selection and Management Process into one indicator. This serves as a screening process for the consideration of supplier parts for future use. The indicators are provided in Table 4.

Table 4. Supply Management Overall Indicator Definitions

Indicator	Definitions
R	Recommended for use in new design
C	Caution for use in new design. Either supplier is not on approved list, or supplier is not qualified (Q1), or part is not qualified (Q2).
D	Do not use in new designs. Part is high risk due to obsolescence, or disqualified supplier or part is disqualified.

2.4.5 Environmental Performance Consideration in Qualification

The existing supplier and parts management qualification process at Nortel Networks does include the consideration of environmental performance but its application is limited and implementation is inconsistent as detailed in Chapter 5. The supplier assessment process states that the "supplier will comply with environmental regulations and will continuously reduce the impact of its operations and products on the environment" (See section 2.4.1.2.5). Compliance to ISO 14001 and/or Corporate Standard 180.65 is also recommended. This Corporate Standard was approved in 1995 for supplier environmental assessment (Nortel Networks, 1999d). This procedure details a prescriptive method to audit a supplier's environmental management system at a specific site and attempts to capture some indication of activities being conducted by the supplier to improve product environmental performance. Procedures for supplier environmental assessment were also developed on a site-by-site basis to meet the individual site ISO 14001 requirements. This situation resulted in different locations and business units approaching the consideration of supplier environmental performance in many different ways with a wide variation in results.

SEAP (detailed in Chapter 6) was developed by the research engineer to replace existing practices, to standardise and align the process and particularly to add focus to the issue of product environmental performance. SEAP as a process was recommended to Nortel Networks and has been modified by the Corporate Environment Group. It will be implemented through the Supply Management function with a set of supplier Core Environmental Requirements. SEAP was developed as a tool to benchmark suppliers, set prescriptive minimum requirements (which may result in direct supplier de-selection) and aid the drive towards continual improvement. In addition, SEAP results for each supplier can be integrated directly into the component or technology qualification process in such a way as to allow supplier environmental performance to have a positive influence on component qualification. The suggested component eco-evaluation methodology is detailed in section 7.1.2.

In terms of existing processes in place to specifically evaluate the environmental performance of components few are evident either within Nortel Networks or in other electronics companies other than compliance to a prescriptive list of substances (Philips, Ericsson, Lucent). In the past, specific material requirements have been stipulated in the specifications of a Nortel Networks design and have therefore been detailed in the component procurement specifications. An example is the sourcing of "lead-free" components for a particular project.

With the introduction of regulatory controls on certain substances in electronics products in Europe (RoHS Directive) the Nortel Networks supply management group plan to capture an appropriate declaration and make it visible in the regulatory field for component qualification.

Supplier hazardous material requirements for products have also been detailed in the supplier Core Environmental Requirements programme in the form of prescriptive lists of materials that Nortel Networks would prefer not to be in their products (see section 7.1.2.1). This programme is still to be formally implemented.

2.4.6 Approved Vendor List Categorisation

Each supplier, when qualified, is placed on the Approved Vendor List (AVL) in a category. This list has three core categories:

- Approved-Preferred Supplier
- Approved-Niche Supplier
- Supplier

An approved-preferred supplier is "a long term, global, contracted, supplier that demonstrates technology and R&D leadership in their field that is complementary to Nortel Networks future product growth, and has proven to have superior quality, delivery, service and demonstrates to be the highest value supplier for a group of commodities" (Nortel Networks ,1999b).

An approved-niche supplier is "a supplier that is qualified for use for strategic purposes and/or market leadership, due to a unique or specific commodity offering which is not available from a preferred supplier" (Nortel Networks, 1999b).

A supplier is "an external business that accepts and delivers goods and services to Nortel Networks at an agreed price, quality and time as the result of a request based solely on the market-acceptable attributes for the goods or services being purchased at the time" (Nortel Networks, 1999b).

In addition to categorisation on the AVL suppliers can be further qualified and integrated into the Value Managed Relationship (VMR) programme. A Value Managed Relationship "involves an extraordinary agreement between Nortel Networks and a company doing business with Nortel Networks in which both entities understand that the business will be managed based on its total long–term value to both companies. Such a relationship must be built on mutual trust, a history of exemplary business practices, and complementary marketing and technological goals" (Nortel Networks, 1999b).

VMR suppliers and preferred suppliers are given the first opportunity to supply any new component, part or commodity. This hierarchy of selection reduces the need for the business and technical capability assessment aspects of the qualification process to be conducted. It also has a significant impact on the supplier selection process for both commercial off-the-shelf and custom components.

Until the introduction of the supplier Core Environmental Requirements Programme which sets minimum environmental performance requirements for approved suppliers to meet (compliance with legislation, an environmental policy and the implementation of an appropriate environmental management system) the only prescriptive environmental performance requirement of suppliers was compliance with regulation. Therefore qualification as a VMR supplier did not involve the meeting of any more stringent environmental performance criteria in terms of company or product environmental management. In fact, results from the SEAP pilot study suggest a significant variation in the environmental performance of VMR suppliers.

Currently, environmental performance of suppliers and products has very limited impact on the supplier or component selection process. The approach is to accept a minimum level of environmental performance as opposed to seeking to use environmental performance proactively as a differentiator and a way of improving medium and long-term business viability. With the introduction of more complex and demanding environmental legislation in the electronics sector in Europe and increasing demand from customers for more information on product environmental performance and products with improved environmental performance a minimal approach is unlikely to be one that supports strong business development.

2.4.7 Commercial Manufacturing Component Sourcing

The third stage of the product life cycle where potential component sourcing decisions are made is during manufacturing and the allocation of high volume contracts to suppliers by the Nortel Networks supply management function.

Rarely are commodities sole sourced. This means that at least two suppliers are qualified to supply a specific component at any one time. For many passive commercial off-the-shelf electronic components (resistors and capacitors) there may be four suppliers with approved-preferred status and another six with approved supplier status. It is the responsibility of the respective Nortel Networks supply management commercial portfolio primes to negotiate and develop contracts with each of the suppliers. The allocation of contracts will be influenced by several factors including the status of the specific supplier strategy and the commodity strategy, cost, security of supply, inventory control etc... At any one time one factor may have greater influence on the spread and allocation of contracts because of changes in the company's business strategy.

A further complication to the supplier selection process now exists with the recent changes in the strategy and structure of the Nortel Networks supply base. In the last two years a significant proportion of manufacturing activities have been out-sourced to contract manufacturers, particularly the manufacturing of printed circuit board assemblies. This practice is a trend that has proliferated throughout the telecommunications industry. It has resulted in the contract manufacturers being given increasingly more control over the selection of suppliers of commercial off-the-shelf components, thus taking advantage of their potential for increased purchasing leverage due to high volume and spend. In this scenario the components and suppliers are still qualified by Nortel Networks and the contract manufacturers are obliged to use suppliers on the Nortel Networks approved vendor list. However, there is a possibility that the contract manufacturers may take increasing ownership of the qualification of suppliers of commercial off-the-shelf components.

2.4.8 Component and Material Selection in Design

Discussions with design groups within Nortel Networks have revealed that because of the time to market pressures regarding new product introduction and the complexity associated with eco-evaluation, designers would prefer that any form of component eco-evaluation be made before components are made available for use in design if possible, i.e. during qualification. Components that are introduced as part of a new design would undergo eco-evaluation during qualification. Hardware (electrical) designers focus primarily on functionality, cost, area, power and weight and it is a sensible suggestion to remove the need for these designers to be involved in eco-evaluations at component level. However, if designers were actively practising ecodesign they would be expected to conduct some form of evaluation at the circuit or circuit pack level, particularly in the consideration of different circuit lay-outs or functionality which would entail different component deployment and placement (e.g. application specific circuit versus standard lay-out). Eco-performance becomes another variable to be added to the trade-off decision-making process in meeting the performance requirements for the product. Component material data and evaluations could provide input to the process and assist in generating data for life cycle decision making at product level such as end-of-life management. Currently, specific environmental life cycle material issues are not considered systematically during hardware design at Nortel Networks apart from mass minimisation for functionality and cost reasons.

2.5 Conclusions

This chapter provides an overview of the dynamic and changing nature of the telecommunications industry and Nortel Networks as an organisation. Because of constant change the organisation is continually reviewing and revising its strategy on environmental performance improvement and investment in environment-related research. It is likely that research programmes and implementation will continue on design for environment, life cycle assessment and product life cycle management in the foreseeable future. Furthermore, environmental performance improvement could become more significant in influencing the overall performance of the company.

It has been stated that any methodologies developed for improved supplier and component environmental assessment or evaluation will have to be incorporated in to the existing supplier and commodity evaluation process.

Chapter 3 Research Programme

The objectives of this chapter are to:

- Introduce the research aims; and
- Outline the framework and the methodology used in conducting the research.

3.1 Introduction

This chapter provides an overview of the conception of the research and a description of how it evolved and how it was managed. The research programme aims were defined at the start and a four-year project plan developed. Because of the "hands-on" nature of the research it was necessary to adopt a flexible approach to the programme plan as many of the activities and milestones specified in the plan were dependant on input from various business functions within Nortel Networks. Certain business decisions that were made, impacted on phases of the research and plans had to be changed accordingly (notably on data capture).

Initially it was envisaged that an action research methodology could be used because the research project is a problem or issue-centred approach. The core objectives of action research are to solve a problem through the development of a practice or solution that will advance the pool of knowledge in the specific situation environment and will improve the understanding of the practice by all involved in the project (see Warmington, 1980). As the devised research programme involved the interaction of many business functions it seemed appropriate that such a methodology be adopted. However, as the programme progressed it became apparent that many of the implementation aspects of the programme would not be accomplished and put into practice. Thus, the applied methodology moved more towards the traditional Popperian view of the logical processes that have to be gone through for scientific progress to be made. This involves generating an hypothesis and devising experiments or actions to prove or disprove it and reporting back to the accepted corpus of knowledge. Of course, action research also includes these steps but it also considers the context of the research and the impact of the parties involved on the research outcome and on themselves.

Thus, the programme of research comprised of the setting of aims, the generation of an hypothesis and a set or core research questions and a set of actions to determine the answers to the research questions and therefore prove or disprove the hypothesis.

3.2 Research Aims and Objectives

The core research project focuses on product life cycle environmental data management and decision-making in product development and manufacturing supply chain management.

The aim is to contribute to improvements in the environmental performance of Nortel Networks products through the development of product environmental information management systems and decision-making methodologies for component selection (as agreed by Nortel Networks and Brunel University).

The core objective is to investigate the feasibility of integrating supplier-specific product-specific environmental data into the ecodesign process and the Nortel Networks Product Life Cycle Management (PLCM) system. The project is one component of a response of Nortel Networks to the increasing need for improved environmental performance of products and company activities. The need for improved product environmental performance in the telecommunications industry and the integration of "green" design practices (ecodesign/DfE) into the product development process are driven by three key pressures:

- customer requests for eco-friendly products and the inclusion of environmental criteria in customer supplier selection processes;
- legislative requirements; and
- ISO 14001 requirements.

The research project involved the investigation and development of methods and tools to meet the information and product environmental performance requirements of customers of Nortel Networks, legislation and ISO 14001 and consequently to improve product environmental performance.

3.3 Research Methodology

The research was regarded as being very much "hands-on" or "real world" in nature. The majority of the research was not conducted in isolation but involved considerable interaction with Nortel Networks business functions. This means that the research engineer could be considered part of an expanded team. The team was used as an essential source of information and was also the final customer for the research results and recommendations. This approach was considered essential if the methods or tools developed and proposed were to stand any chance of being implemented and integrated into current or future systems within the company. Ensuring the "team" remained informed of all progress and was included in any decision-making that resulted in impacts upon the project was very important. In addition it was necessary to remain abreast of all developments that may have affected the project as both the ecodesign and the telecommunications fields are fast moving and dynamic.

An overview of the research methodology framework used in the EngD research project is depicted in Figure 2. The process consists of defining the problem, investigating relevant previous work conducted in the field, generating options, planning, implementing, testing and reviewing solutions in a cycle until a decision is made to implement the recommended solution. After implementation the practice should be monitored and evaluated for performance and continued effectiveness and a revision plan developed if necessary before entering the improvement loop again.

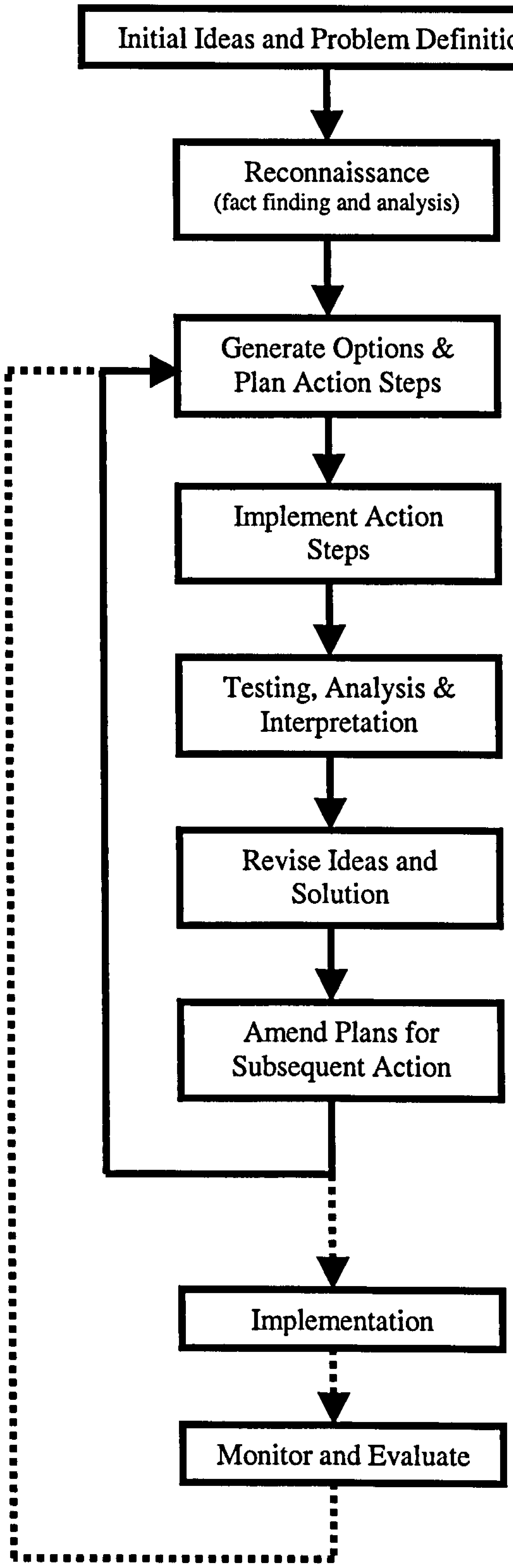


Figure 2. Overview of the Research Methodology

However, because of the resulting lack of implementation of the proposed solutions in the time frame of the research the final element of the framework could not be completed. Implementation failed in the time frame because of a lack of support for the research findings from within various business functions within Nortel Networks. Another valuable observation is that in an organisation the size of Nortel Networks obtaining support for new, sometimes-radical processes at a high level in the company is very difficult. Also it is not unusual that many research programmes fail to get adequate exposure to senior individuals in the company who are the key decision makers.

3.4 Project Management

The research methodology described in section 3.3 provided a top-level research framework for the research project. The project was driven by a core hypothesis that equates to the problem definition phase of the methodology framework in Figure 2:

Hypothesis

Supplier product and company environmental data can be integrated into the Ecodesign and Product Life Cycle Management systems of Nortel Networks or any telecommunications network solutions company.

To prove or disprove this hypothesis a set of research questions was generated with associated programmes of work (see Figure 3).

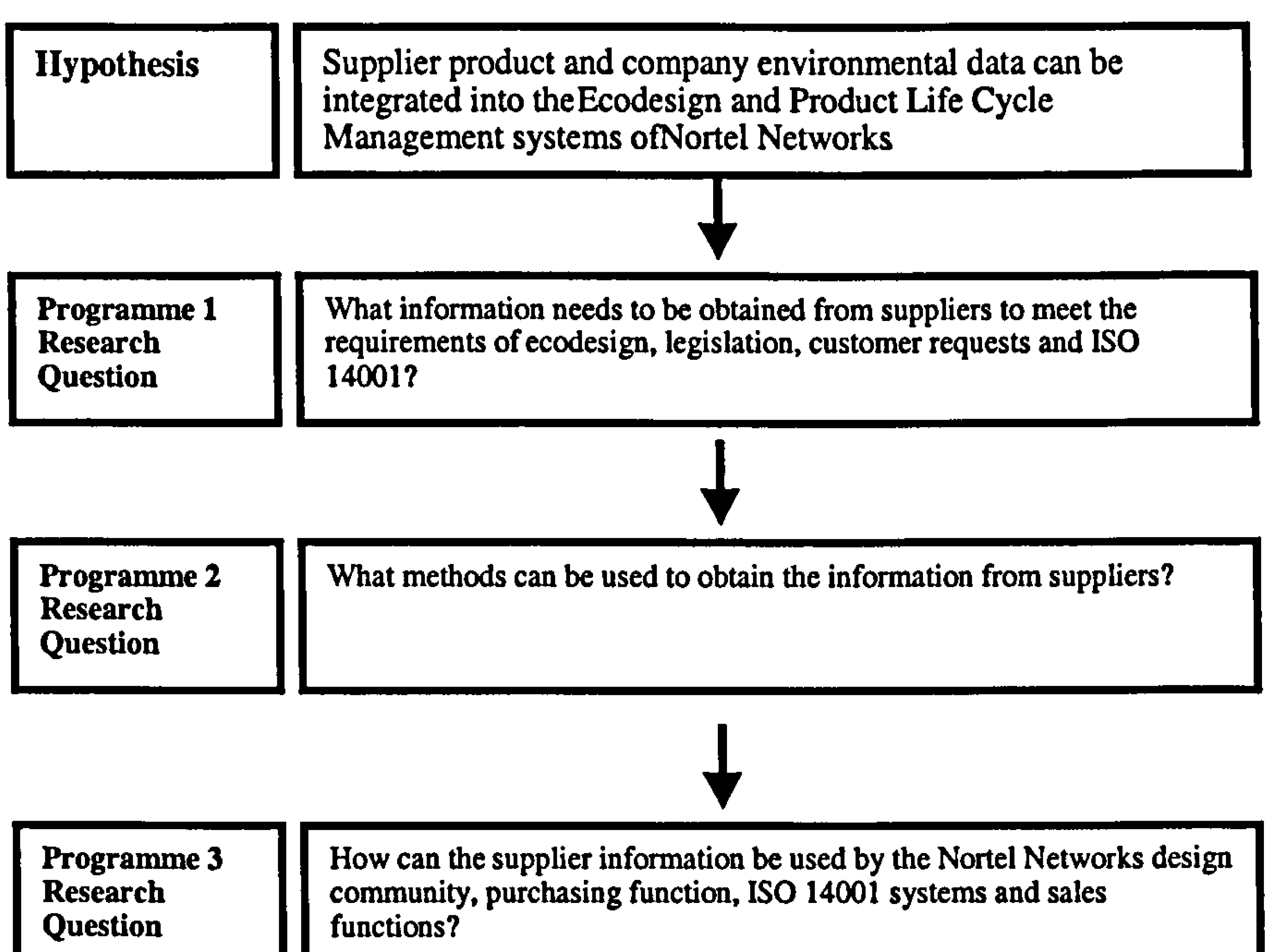


Figure 3. Research Questions and Programmes of Work

Each of the research questions leads to a programme of work. The three programmes were broadly conducted in chronological order although elements of concurrency did emerge as the project progressed. A project management plan was generated to provide a detailed road map in terms of specific objectives, activities and time frames for completion of each programme and of the complete project. Project details were also documented in a Nortel Networks "Work Package Description" for adherence to internal quality management requirements. The project management plan can be seen in six-month report number 4 (second year dissertation).

Programme one consisted of reviewing customer information requirements and legislation and the development and implementation of a gap analysis to determine the data capture requirements.

Programme 2 involved the investigation of data sources and methods for data capture focusing on a web-based technology solution.

Programme 3 consisted of developing a sophisticated method for component eco-evaluation for component qualification and feasibility testing of the generation of product material profiles using three case study products.

At the start of the research it was anticipated that the data capture element of the research would be implemented and the framework in Figure 2 followed to the letter. This would have yielded some valuable results in terms of exploring further iterative steps to refine and improve the data capture process. In hindsight it was, perhaps, naïve to assume that the methods would be implemented.

The initial focus was also purely on capturing data for component evaluations. However, it was clear early on in the research programme that supplier environmental evaluation methods generally had also to be developed. The six-month reports detail the change in scope.

Chapter 4 Background

4.1 Introduction

The aim of this section is to provide an overview of work conducted in the field of research that provides a context for the research project. It demonstrates the RE's awareness and understanding of the field of study, research previously conducted and provides a context for the RE's contribution to knowledge. Initiatives and relevant bodies of work are also discussed in chapters 5, 6 and 7.

Due to the nature of the project, several core bodies of literature have been consulted, each focusing on a particular aspect of the overall research. They can be simply categorised as:

- Ecodesign;
- Supplier environmental assessment and supply chain management; and
- Customer request responses;

All relevant literature was identified by conducting searches in various databases for books, journal articles, conference proceedings, PhD dissertations, newspaper articles, company documentation and web sites. A list of the literature identified and obtained for each of the above sections and those included throughout this document is provided in the references section.

4.2 Ecodesign

The research project is focused on ultimately improving the environmental performance of Nortel Networks products through improved Product Life Cycle Management practices. PLCM encompasses all activities associated with managing the environmental issues of a product from cradle to grave. Simplistically this will include ecodesign, use and product takeback.

Ecodesign is central to product (or service) environmental performance improvement. Throughout this chapter reference will be made to products but the same principles and concepts can be applied to services and one of the ideologies of improved product environmental performance is that products should increasingly be thought of as providing a service rather than a commodity or physical entity. But what is meant by product environmental performance improvement? In simple terms it means the reduction in the use of resources that are inputs to the product lifecycle and the reduction in pollutants or environmental burdens that are outputs of the product lifecycle. It is at the design stage in the lifecycle where key decisions are made that will have dominant influence on the environmental performance of the product. Examples are the mass and type of materials used (in terms of resource depletion, toxicity and recyclability) and the energy consumed. The principles and practices of ecodesign can be applied to the design of any product or service.

4.2.1 Definitions

As the field of ecodesign (also known as Design for Environment (DFE)) has grown phenomenally over the last five years a plethora of definitions have developed. Examples are provided below.

"Design for Environment is an objective technique for making environmental considerations an integral part of the design of the product, process or technology." (White, 1999).

"Design for Environment is a novel approach to systematically reduce or eliminate environmental impacts throughout the life cycle of a product or process by accounting for potential impacts at the outset and during the continuing course of the design process" (Digital Equipment Corporation et al, 1997).

"Environmentally Conscious Product Design, often referred to as Design for Environment or Ecodesign, aims to make efficient use of natural resources over the entire life cycle of products. It is not simply improving a product, it means embedding the environmental issues in the product policy and strategies and in the product creation process." (Philips Electronics N.V, 1997).

"Integrating environmental considerations systematically into the design of products, processes and services is called Design for Environment (Ecodesign). Ecodesign practices are intended to develop environmentally compatible products and processes while maintaining or improving price, performance, and quality standards." (The Environment Council, 1997).

Ecodesign is "Design which addresses all environmental impacts of a product throughout the complete life cycle of the product, without unduly compromising other criteria like function, quality, cost and appearance."(Eco$_2$-IRN, 1998).

Ecodesign is "systematic consideration of design performance with respect to environmental, health and safety objectives over the full product and process life cycle" (Fiksel, 1996).

Each of the above definitions contains individual subtleties but most include the terms environmental impacts or considerations, and life cycle. Both The Environment Council and Eco2-IRN also incorporate other important criteria that product design must take into account such as cost, quality and function. This is an important practical consideration as ecodesign principles must be complimentary to other DFX (Design for "X") practices such as those suggested by Graedel and Allenby (1995) which include assembly, regulatory compliance, manufacturability, reliability and testability.

In addition to the term ecodesign, there are two other terms that characterise the level of environmental consciousness deployed in the design process. Poyner (1998) suggests that "green design" sits at the bottom of the environmentally conscious design hierarchy as it treats the environmental design of the product as an objective rather than a constraint. This mainly involves consideration of the materials in the product and it's end-of-life fate (Mackenzie, 1991). Ecodesign is second in the hierarchy because it considers a wide range of environmental burdens enabling the designer to prioritise certain impacts and target them for improvement. "Sustainable design" sits at the top of the hierarchy as it goes way beyond the constraints of the fit, form and function of the product as a focus of the design and considers the societal need for the production of the product in the first place, consumer attitudes and ownership. It could be argued that ultimately sustainable design should be the objective of product manufacturers but it requires a paradigm shift in social, political and economic attitudes and principles. Certainly Nortel Networks, and I would suggest most of their competitors, are not committed to moving towards sustainable design. I do, however, believe that one day they will have to.

4.2.2 Ecodesign Principles

A comprehensive ecodesign approach for products will consist of the application of a combination of practices developed to improve eco-efficiency and perhaps to achieve a certain set of environmental performance goals. Some practices result in improvements that are self-evident e.g. mass minimisation, others may require further analysis to establish the degree of improvement e.g. material toxicity. The fundamental targets for the practices are reduction in resource use and reduction in pollution over the entire life cycle of the product while satisfying costs and performance requirements in order that the product remains competitive.

Fiksel (1996) describes the core ecodesign practices as:

- Material substitution;
- Waste source reduction;
- Substance use reduction;
- Energy use reduction;
- Life extension;
- Design for seperability and disassembly;
- Design for recyclability;
- Design for disposability;
- Design for re-usability;
- Design for remanufacture; and
- Design for energy recovery.

Graedel and Allenby (1995) suggest "the least difficult way to ensure that environmental principles are internalized into manufacturing activities in the short term is to develop and employ ecodesign as a module of existing DFX systems. Moreover, the fact that ecodesign is intended to be part of an existing design process acts as a salutary constraint, requiring that ecodesign methods and analysis be implementable in the real world".

This statement may be true, but the challenge lies in the training of designers in ecodesign principles, the provision of suitable tools that are compatible with existing Computer Aided Design (CAD) tools, and the development of a transparent procedure for product design environmental impact comparison, which also minimises the affect on time to market.

Central to any application of ecodesign is life cycle thinking. The designer needs to consider the entire life cycle of the product from "cradle to grave" or even "cradle to cradle". This will ensure that environment impact reduction in one phase of the life cycle does not result in greater environmental impact in another and that responsibility for the product exists beyond the factory gate right to end-of-life. The typical product life cycle with end-of-life loops is shown in Figure 4.

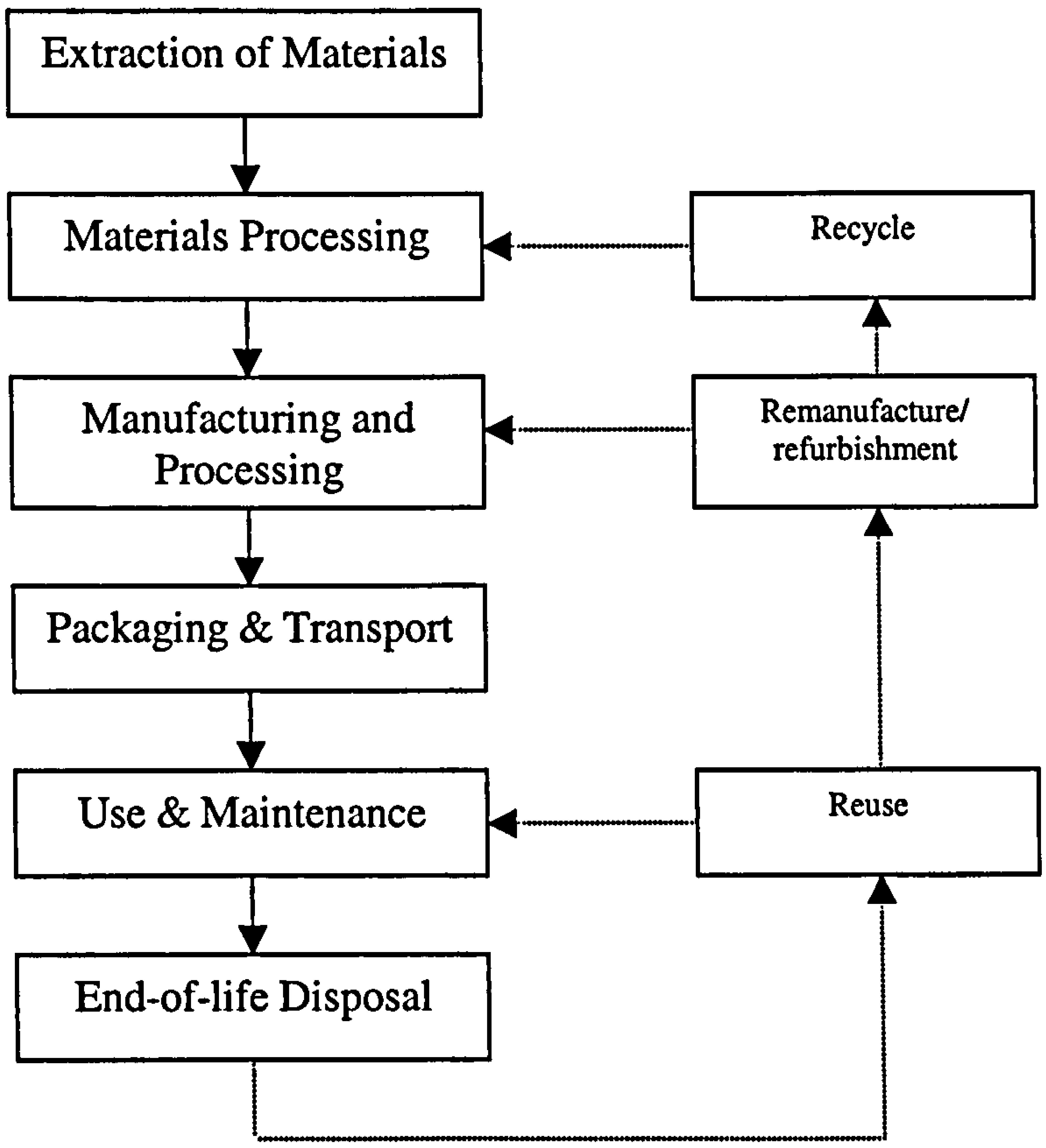


Figure 4. The Product Life Cycle

4.2.3 Ecodesign Implementation Challenges

Fiksel suggests that "to perform ecodesign consistently and effectively is challenging for several reasons:

- The necessary environmental expertise is not widely available among product development engineers;
- The complex and open-ended nature of environmental phenomena makes them difficult to analyse; and
- The economic systems in which products are produced, used and recycled are much more difficult to understand and control than the products themselves."

The first point highlights the need for an extensive training programme in companies implementing ecodesign across the company design community as the majority of product designers have no formal training in environmental design issues. This illustrates the cross-functional nature of ecodesign. The environmental "expert" has to communicate environmental issues effectively to the design engineer.

The second point indicates the potential high complexity of ecodesign. The use of certain ecodesign initiatives in the design process, such as mass reduction, will undoubtedly contribute to the reduction in the environmental impact of the product. Many simple ecodesign practices can result in the improved environmental performance of products. The difficulties arise when the product itself is highly complex, when the total life cycle is considered or when two or more designs of the same product are compared.

If a total ecodesign approach is taken the decision-making process for improvement of product environmental performance becomes extremely complicated. Certain methods need to be used to aid the decision-making process and to balance a range of trade-offs.

One tool or technique, which can be used as a component of ecodesign to address some of the difficulties, is Life Cycle Assessment (LCA). LCA "systematically considers and quantifies the consumption of resources and the environmental impacts associated with a product or process. By considering the entire life cycle and the associated environmental burdens, LCA identifies opportunities to improve environmental performance." (Hendrickson et al, 1997).

However, Hendrickson et al have criticised LCA for several problems, "including:

- There is a lack of comprehensive data for LCA;
- Data quality is not uniformly high;
- Defining problem boundaries for LCA is arbitrary and controversial;
- LCA is too expensive and slow for application in the design process;
- There is no single method that is universally accepted;
- Equally credible analyses can produce qualitatively different results;

- Modelling a new product or process is difficult and expensive; and
- LCA cannot capture the dynamics of changing markets and technologies."

Conclusions from previous research conducted at Nortel Networks (Francis, 1999) also suggest that LCA may not be a practical and viable product development tool in organisations using complex concurrent engineering and design. The reasons are:

- complex systems;
- complex product data management;
- difficulties in product data acquisition; and
- cost and resources.

Francis (1999) concluded that LCAs need to be carried out by specialists in the organisation and that it is not feasible for a designer to conduct a full LCA as a component of an ecodesign procedure. This conclusion is not dissimilar to general opinion that has been voiced on the application of LCA in the electronics industry. In contrast ecodesign is widely accepted in the electronics industry as a suitable design technique for improving the environmental performance of products.

A considerable amount of research on the development of LCA techniques is still being conducted both in academia and in industry to try to address some of these problems (ISO standardisation of LCA methodology). It is generally accepted that conducting a comprehensive product/process-specific LCA at the design stage may not be feasible. Particular emphasis in research in industry is placed on the development of "tools to do the job", such as streamlined, quick environmental performance evaluating tools incorporating varying degrees of LCA methodology (Hendrickson et al (1997), Nissen et al (1997) and Matzke et al (1998)).

Other methods or techniques are available to the decision-maker in regard to ascertaining the environmental performance of a product or design. These include qualitative methods such as checklists and matrices and also environmental accounting (see Appendix I for two examples of checklists). Qualitative methods have a number of obvious advantages over quantitative methods (e.g. LCA). They are easier to apply, require minimal data and can be useful despite large uncertainties (Fiksel, 1996).

Checklists may be paper-based, electronic as part of an ecodesign tool or integrated into existing design packages. More complex, quantitative methods are typically software tools and a range are now commercially available e.g. EIME, Eco-Indicator. The latest tools are increasingly Internet-based. Some organisations have developed their own bespoke solutions to meet their needs (Nortel Networks, IBM, HP, Motorola). An overview of a range of commercial ecodesign software tools can be found in Poyner (1998). Examples of proprietary ecodesign tool development can be found in the Institute of Electrical and Electronic Engineers annual International Symposiums on Electronics and the Environment (1993 – 2002).

4.2.4 Ecodesign at Selected Example Electronics Organisations

This section consists of brief overviews of leading ecodesign programmes in the electronics industry. They have been selected because they are considered to be pioneering in this field.

4.2.4.1 Philips Electronics.

The following details are taken from the 1998 Philips 1998 Environmental Report – Ecovision (Philips, 1999).

"Philips strives to integrate functionality and sustainability by balancing innovation with ecological impact. This means continuous improvement in both areas, with a focus on products, packaging and processes. Philips is building an extensive experience and a knowledge of how to green products with Ecodesign."

In order to enhance environmental performance, Philips focuses on five green areas during ecodesign:

- Weight;
- Hazardous substances;
- Energy consumption;
- Recycling and disposal; and
- Packaging.

Product developers analyse every stage of the product life cycle. In most divisions the EcoScan computer program is used to calculate the environmental impact of the product, which is expressed in terms of an Eco-Indicator. The Eco-Indicator makes it possible to compare the environmental impact of the different life stages of the product. If a product meets the Ecodesign criteria and has a better environmental performance than the chosen reference in one or more of the Green Focal Areas (and is equal in the rest) it can be selected as a Green Flagship product. The Ecodesign programme is an integral component of the ISO 14001 environmental management process.

4.2.4.2 IBM

The following details are taken from the IBM 1998 Environmental Report (IBM, 1998).

"IBM's Environmentally Conscious Products (ECP) program was established in 1992. Unique to the industry in its technical breadth, the program has pioneered the industry's best practices in design for the environment (ecodesign), product recycling technologies and product environmental metrics. The program has established five environmental design objectives for IBM products:

- Develop products with consideration for their upgradeability to extend product life;
- Develop products with consideration for their reuse and recyclability at the end of product life;
- Develop products that can safely be disposed of at the end of product life.
- Develop and manufacture products that use recycled materials where they are technically and economically justifiable; and
- Develop products that will provide improvements in energy efficiency and /or reduced consumption of energy."

The ECP requirements have been incorporated into IBM's Integrated Product Development process.

4.2.4.3 Lucent Technologies

The following details are taken from the Lucent Technologies 1997 Environment, Health and Safety Report (Lucent Technologies, 1998).

" Lucent Technologies knows that Design for Environment (ecodesign) is a key in distinguishing our processes, products and services. We have established a cross-functional ecodesign team to implement the changes necessary to support our vision of being a responsible company that fully integrates life cycle consequences into each of its business decisions and activities. We have also established a Product Lifecycle Team to facilitate company-wide minimisation of potential cost and liability associated with equipment disposal, electronic and contaminated scrap, asset recovery and product reuse."

Lucent aims to develop and apply design for the environment criteria for all its operating units by the year 2000. "20 products have been subjected to an "environmentally responsible product" evaluation using a methodology developed internally."

4.2.5 Examples of Ecodesign Practices Applied to Products

The following examples are sourced from EIA (1999). These case studies have been chosen because they emphasise the simplicity of many ecodesign practices and that many such practices align with cost reduction exercises. It is clear that many global organisations are seeing the value and benefit of implementing ecodesign.

4.2.5.1 Material Selection

- The design of Hewlett-Packard's OfficeJet 500 multi-purpose printer has eliminated the need for plastic flame retardants by using a metal chassis and power supply enclosure, utilises light-emitting diodes instead of a mercury lamp for the scanner and eliminates the need for batteries by using flash memory technology
- Lucent's Wireless Customer Adaptor was designed to incorporate new environmental constraints, such as elimination of Nickel-Cadmium batteries and eighty five percent reduction in usage of lead solder.
- The world's first virtually lead-free telephone was developed by Nortel Networks.

4.2.5.2 Reduction in the volume of material, miniaturisation

- Motorola's Eagle i1000 combines the capabilities of a digital cellular phone, two-way radio and pager in a light-weight, palm-size handset, thus eliminating materials that would otherwise be used in producing multiple products.

- The product volume of Philips Consumer Electronics audio and communication products has been substantially reduced (30-50 percent compared with same functionality some five to ten years ago.

4.2.5.3 Use of recycled materials

- Since 1992, Hewlett Packard has replaced expanded polystyrene endcaps with recycled pulp endcaps in virtually all of their LaserJet toner cartridges.
- The eight major plastic parts of IBM's 6893 IntelliStation r Pro system unit are now made with one hundred percent recycled plastic resin.

4.2.5.4 Selection of materials that are easily recycled

- Kodak's One-Time-Use-Camera parts are made form polystyrene that have enabled reuse/recycling of over two hundred million cameras.
- All of Sony's plastic housings are recyclable and all returns are recycled. Sony's recycling programs then return the plastics to markets as commodities and work continues to improve the economics of these return systems. In one camcorder model, Sony has replaced plastic with a magnesium housing, which greatly increases the recyclability.

4.2.5.4 Upgradability

- IBM Printing Systems Company's InfoPrint 4000 printer models are designed for upgradability; the 3900/4000 printer engine has been upgraded nineteen times since 1990, enabling customers to upgrade their equipment rather than dispose of it.

4.2.5.5 Refurbishment

- Sun extends the life of its older equipment by refurbishing it and selling it as re-marketed equipment. Remarketed systems, sold as used, generate more income than would recycling the parts. Compared to building from scratch, fewer resources are needed to rebuild systems or to test unused systems that are classified as "used".

4.2.5.6 Remanufacturing

- As part of Kodak's remanufacturing efforts, valuable electronic parts such as circuit boards, power supplies, CRTs, print heads, copier-printer fuser rollers are returned from the field for remanufacturing. These reconditioned products are quality tested and returned to the supply chain reducing raw material consumption.

- In 1997, Xerox remanufactured equipment form more than thirty thousand tons of returned machines, diverting them form landfills and effectively reducing raw material and energy consumption.

4.2.5.7 Disassembly

- A growing number of Hewlett Packard products are designed to be easier to take apart and recycle. Many components simply snap apart making it easier to separate metal from the plastic.
- IBM's DfE guidelines encourage the use of snap fits over fasteners, and where fasteners are necessary, the use of industry-standard fasteners with a minimum number of head sizes and types and which do not require special tools when dismantling.

4.2.5.8 Recylcability

- Hewlett Packard has reduced the number of toner cartridge parts by twenty one percent, thereby reducing the amount of material used and increasing recycling capability. HP also uses an innovative foam chassis to reduce the number of parts needed to build some of its products and to make them easier to disassemble for recycling.
- Hewlett Packard helps facilitate recycling by marking all plastic parts according to ISO 11469 and by moulding user instructions into the plastic instead of using a paper label.
- Avoidance of the use of adhesives, decorative coatings and finishes on IBM products have realised measurable benefits at end-of-life.

4.2.6 Ecodesign at Nortel Networks

Ecodesign was first considered at Nortel Networks in the early 1990s although the approach has been somewhat fragmented with several research and development groups investigating the development and implementation of various tools and methods. Significant early milestones include the issue of Design for Environment Guidelines for

Nortel Physical Designers (White, 1997) and the application of ecodesign in the development of the world's first lead-free demonstration telephones.

Over the last four years a programme to develop and implement a corporate-wide ecodesign strategy incorporating several decision-making tools has been underway. The RE has been a participatory team member in this programme. The work included research on LCA (Francis, 1999) and ecodesign software tools (Poyner, 1998). Several design teams in different Lines of Business (LOBs) have been trained to use ecodesign. The programme has culminated in the launch of an Ecodesign Solutions Set – an ecodesign tool suite.

The Solutions Set consists of three developed web-based tools (see Figure 5):

1. Product Environmental Compliance Checklist (PECC)
2. Nortel Ecodesigner (NED)
3. Environmental Product Opportunity Assessment (EPOA)

Each tool is used in chronological order as above during the product development process. PECC is used at the product conception stage to identify potential compliance risks associated with the product in terms of legislation, possible market restrictions and customer requirements. NED is used during the product design stage. It is a simple, practical tool that facilitates effective ecodesign. The designer selects ecodesign strategies to apply to the design of the product from categories such as hazardous materials, mechanical, electrical (see Figure 6.). The application of the strategies is then documented and version controlled using Livelink on the Intranet. The process forms a part of the ISO 14001 programme for each site with design functions.

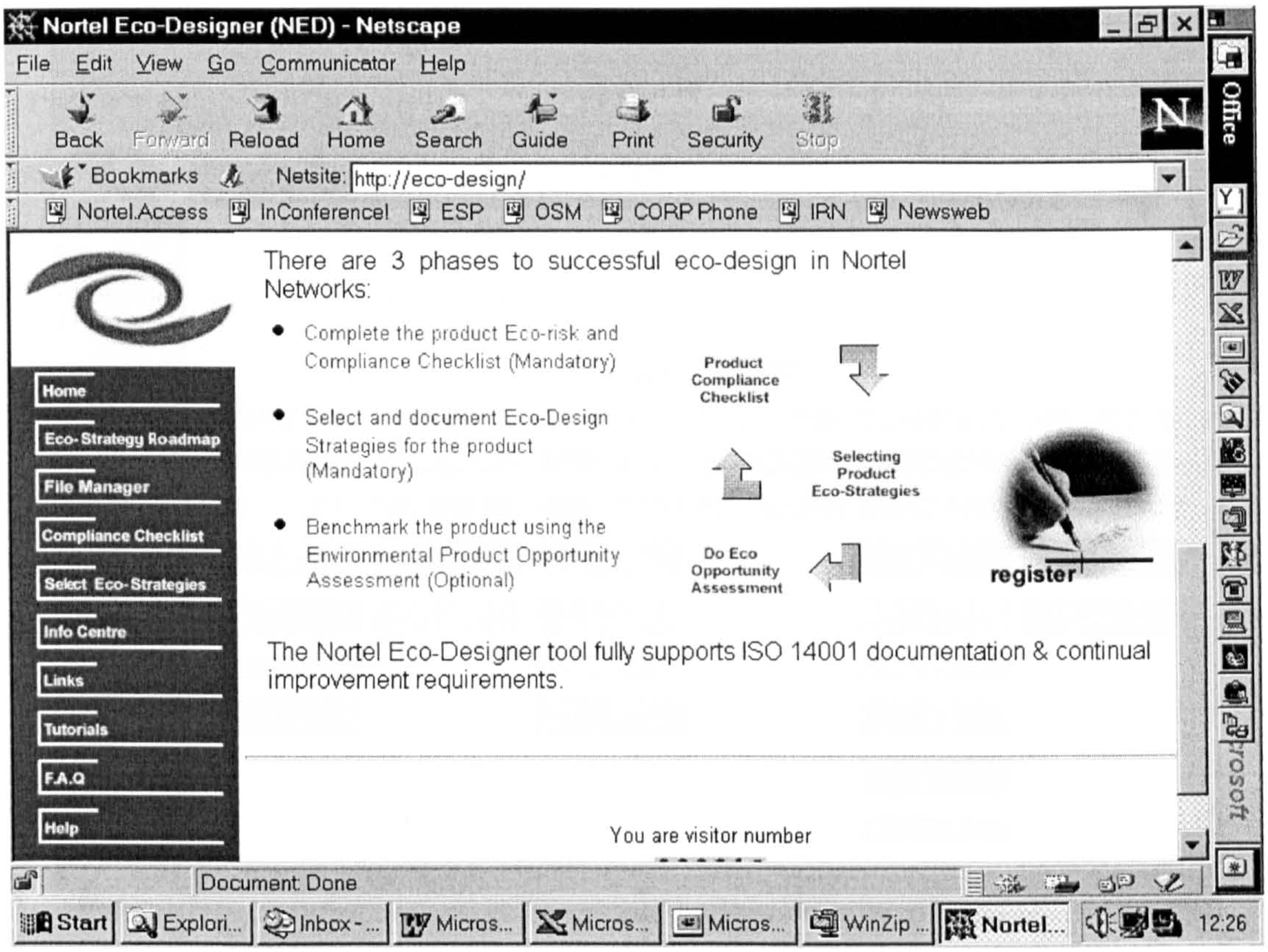


Figure 5. Ecodesign Solutions Set Web Tools

EPOA is a method developed internally to quantify the environmental performance of products. It is used to establish a baseline for continuous environmental improvement and to assist in meeting the requirements of legislation and customers.

Certain aspects of NED and EPOA focus on materials present in the product and opportunities for recycling and recovery. However, strategies for avoidance of certain hazardous materials and use of recyclable materials in NED and the identification of the presence of hazardous and recyclable materials in EPOA require detailed information of the material composition of components within products. Such detailed information can only be provided by the supply base. The possibilities for the creation of the fifth piece of the jigsaw are investigated in this EngD research project (see Figure 7). SEAP (Supplier Environmental Appraisal Procedure) is a method developed by the RE and is detailed in Chapter 6.

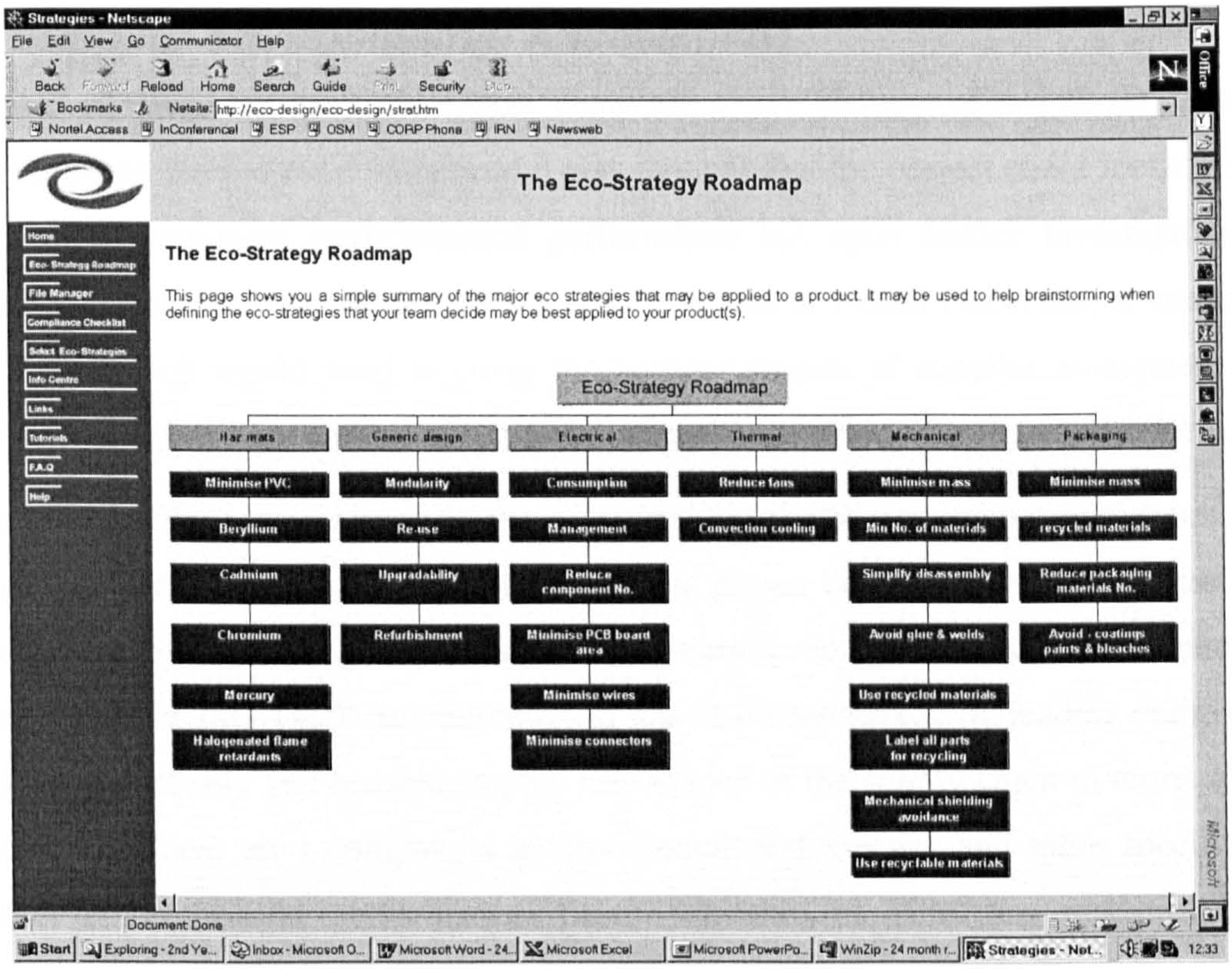


Figure 6. Ecodesign Strategies

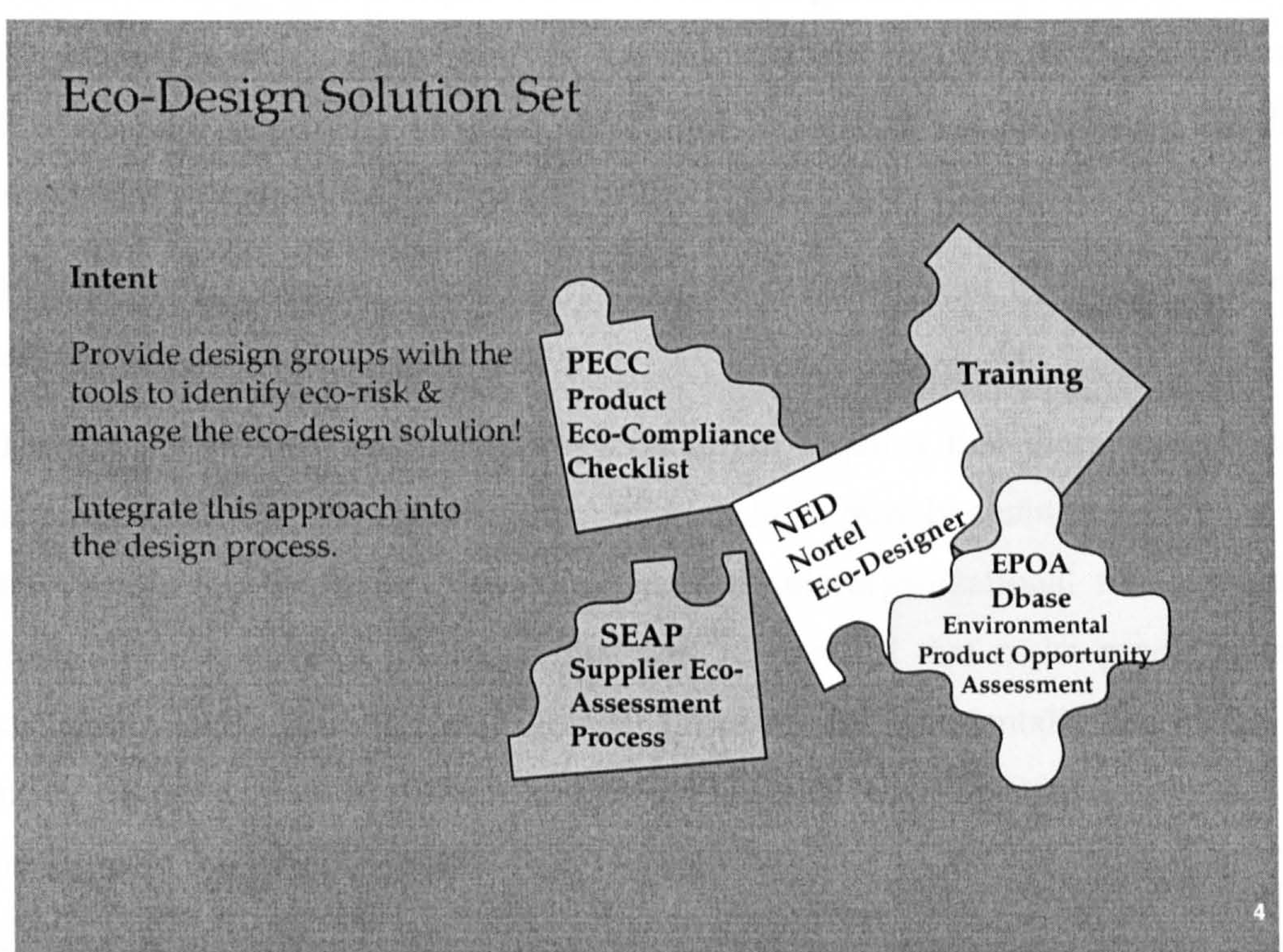


Figure 7. SEAP and the Ecodesign Solutions Set

4.3 Supplier Environmental Assessment

Methods of interaction with the supply chain are a core element of this EngD research project. When the project commenced it was thought that the project could focus purely on product/component environmental performance but upon further investigation of current "supplier environmental assessment" practices at Nortel Networks, it was clear that the research would need to cover the broader aspects of supplier assessment and provide input to the generation of a supplier interaction strategy for the environment.

Over the last five years, interest in the assessment of the environmental performance of the supply chain in the electronics industry has grown considerably. The interest has been driven by increasing demands from legislation, customer requirements and the requirements of ISO 14001 accreditation. It has also been driven by leading companies thinking proactively and recognising the importance of the supply chain in terms of the affect it can have on a company's environmental performance and more specifically product environmental performance. Brian Whitaker of IBM has recognised the importance of supply management:

> "..it is fair to say that the supply chain is one of the most powerful weapons available in the pursuit of improved environmental performance, but like so many other such weapons, we have not yet learned how best to use it. But unlike these other weapons, we really have no choice but to learn to use it properly for the benefit of the human race"(Whitaker, 1995).

Sarkis et al (1995) stress the need for strong inter-organisational relationships in order to meet the demands of industrial ecology:

> "The growth of an industrial ecology paradigm requires that there must be an increased focus on interorganizational relationships. Supply chain management is one vehicle that addresses the importance of interorganizational relationships. There are a number of initiatives that can be pursued that make procurement, purchasing and subcontract management functions environmentally conscious. A strong supply chain will provide an environmentally benign product or service to the ultimate customer".

Two other examples of the growing recognition of the importance of supply chain environmental performance are the establishment of an Ecodesign and Supply Chain Management Project by the Centre for Sustainable Design in collaboration with the

Department of Trade and Industry in the UK (Charters, 1999) and the presence of the following statement in the United States National Electronics Manufacturing Initiative (NEMI) 1998 technology roadmap:

" There is a major need for industry to develop an efficient method to exchange environmental data between supplier and customer.... Of primary importance is the development of standards and requirements for collection, documentation, and transmittal of information about the material content of components, assemblies and systems. Not only is this information needed to effectively and safely dispose of products at end-of-life, it is required by systems manufacturers and their suppliers in order to respond to the growing number of environmental inquiries related to their products. " (NEMI, 2000). This statement sums up the focus of this EngD research project.

4.3.1 Supplier Evaluation and Commodity Assessment Initiatives

This section consists of a review of some of the key supplier environmental assessment and material selection initiatives developed by electronics companies, collaborative electronics organisations, and selected, non-electronics industry organisations. They are presented here because they are considered to be "leading edge" and thus provide valuable input to the research programme.

Hewlett Packard

In 1994 and 1996 Hewlett Packard published details of their initiative on supplier environmental management (Maxie, 1994 and Choong, 1996). The focus is on the implementation of supplier environmental performance ("E") criteria at global and commodity levels. These criteria are combined with existing supplier metrics (technology, quality, responsiveness, delivery, and cost). The emphasis is not on prescriptive dictation but on suggestive guidance underlined by the policy that HP will favour environmentally progressive suppliers. The global criteria are:

i) Environmental Improvement Policy;

ii) Implementation Plan with Metrics; and

iii) Elimination of Ozone Depleting Substances.

Commodity teams are given the opportunity to select their own criteria. For resins the criteria concentrate on recycling, environmental awareness and waste reduction. The initiative resulted in the launch of the first HP DeskJet with recycled plastics.

This approach is one of persuasive encouragement rather than the specification of requirements with a view to improving the environmental performance of the supply chain.

Quantum Corporation

Quantum Corporation, a leading supplier of disk drives to Original Equipment Manufacturers, has implemented a system based on restricted substances that enables the company to specify commodity material conformance requirements to suppliers (Chambers and Cox, 1996). The system was developed in response to increasing numbers of requests from customers for information on the hazardous substance content of Quantum products. Quantum have adopted an interesting approach as they advocate the involvement of themselves, as a supplier, in the technology roadmapping of their customers. This means that the relationship between themselves and both their customers and suppliers is strengthened and they can anticipate requirements and pass them on to their suppliers.

Digital Equipment Corporation

Mulder (1998) provides an overview of "green purchasing" approaches and evaluation methods including:

- Environmental questionnaires;
- Supplier presentations
- Lists of green requirements and specifications
- Ad hoc evaluation
- Life cycle costing-based
- Scoring methods
- Use of voluntary eco-labels; and
- Use of general evaluation guidance.

Mulder outlines the Digital Equipment Corporations' experience of being on the receiving end of a multitude of disparate information requests and requirements. The development of the SITO (Swedish IT federation) Eco-Declarations (starting January 1997) is marked as a success and the European Computer Manufacturer Association (ECMA) Technical Report 70 is hailed as a way forward. TR 70 is designed to be a guide to the declaration of environmental attributes of electronic products (Granda et al (1998). It is offered as an alternative to the proliferation of ecolabel schemes. Mulder sees it as being a format for presentation of environmental attributes (including energy consumption, specific material present and recycling/disposal information) to customers.

Texas Instruments Incorporated

Lizotte (1995) suggests using an abridged LCA for communication of product environmental performance between supplier and customer.

Delft University

Delft Research Laboratory for Sustainable Product Innovation and industry partners (Sony, Digital, Philips) have developed a supplier self audit ecodesign tool —ECO-QUEST (Brink et al, 1998). ECO-QUEST is a questionnaire-based ecodesign tool downloadable from the Internet. It is particularly targeted at SMEs from Newly Industrialised Countries. The user is required to answer product and company environmental management questions. The answers are then evaluated and a score provided. Environmental priorities and suggestions for improvement are then offered. Information on ecodesign is also provided on the web site. The tool has similarities to the objectives of this EngD research project although the evaluation and data management requirements differ considerably.

Ohio State University

Stuart (1998) stresses the importance of material selection in life cycle design for both component selection and assembly in her 1998 paper. She describes the need to adopt a life cycle approach and to consider options for manufacture and end-of-life. Methods of evaluating designs are described such as financial approaches, LCA, environmental indices and analytical models for recycling. Stuart advocates the use of the emerging product process and consideration of environment (EPPACE) model to analyse the economic, environmental and quality differences between different product and process alternatives. These evaluation models could be integrated with a component qualification process and/or supplier selection process. The main focus is on decision-making for product design (ecodesign). The RE sees this application as the step after component qualification and supplier selection although feedback loops would need to be in place.

Delf University of Technology and Lucent Technologies

Nagel (1998a, 1998b, 1999, 2000a, 2000b and 2000c) has conducted a considerable volume of work on methods for evaluating product environmental performance in the supply chain. The supply line engineering project at Lucent aims to integrate supply chain environmental data into Lucent's product development process. The main objective is to attempt to use supplier environmental data in the component selection process and drive innovation and partnership through a supply chain management approach. There are two key elements to the work

- A complex component evaluation methodology incorporating input/output and environmental load calculation for component manufacture; and
- The promotion of an integrated supply chain management partnership approach to drive innovation in the supply chain towards a sustainability objective.

Nagel has tackled supply chain evaluation in a similar manner to the RE. The component evaluation methodology is highly complex and data intensive. It is difficult to envisage how such a method could be incorporated into the business practices of a multi-national organization. Nagel acknowledges that work is still very much in a research phase (Nagel, 2001). However, it provides a valuable contribution to the field of supply chain management. The key learning point is that it is very easy to generate methods that are overly complex and difficult to implement. Industry needs simple and effective tools developed and based on sound science .

IBM Corporation

As IBM re-organises it's manufacturing operations to incorporate an increasing volume of outsourced components and sub-assemblies the company is considering optimal solutions for extending their Environmentally Conscious Product programme into the supply base (Gabriel et al, 2000). This is involving a combination of guidance and requirements in terms of communication with suppliers. For material and substance issues, a list of substances not permitted in IBM products is communicated to the supplier. Gabriel et al acknowledge that this information is not sufficient to answer all customer requests for information and that there is a need for a standard method for material content data capture.

Collaborative Initiatives

Several initiatives on the capture of product material content have been ongoing and developing during the four-year EngD research project. A considerable volume of work has been completed by Malhammar (1998 and 2000) on material declaration questionnaires (initially with the Advisory Committee on Environmental Aspects at the IEC). Much of this work focused on common agreement of which substances should be declared (Malhammar, 1998). Malhammar and Ericsson have since piloted a web-based data capture tool for material declarations with mixed results (Malhammar, 2000).

The GreenPack project is also attempting to reach the same goal (Bergendahl and Segerberg,1997 and Bergendahl et al, 2000). This is a Scandinavian initiative driven by IVF, The Swedish Institute of Production Engineering Research, which also seeks to agree on a materials declaration format and databasing structure.

In 2000, another collaborative group formed under the umbrella of EICTA (European Information and Communication Technology Industry Association) with a vision to again attempt to harmonise an industry-wide approach to product material content data capture (Adams, 2001). The start of the project centred on agreeing a list of substances to declare and the format. The RE was involved in this collaborative project. Currently the group is attempting to select a vendor for the centralised data management component and is also discussing further collaboration with the Electronic Industries Alliance in the United States and the Japanese Green Procurement Initiative to agree on a truly global industry solution (see chapter 6).

One of the first attempts at producing a standard for supplier environmental assessment was the development of the Computer Industry Quality Conference (a network of U.S. computer system producers) environmental practice standard (CIQC STD 0014) in 1996. This standard was based on the Pacific Industry and Business Association environmental practice questionnaires. Part I consists of questions on continual improvement and compliance assurance addressing the fundamental elements of an environmental management system, Part II consists of risk assessment which addresses environmental practices and risks. The standard "has business and procurement focus with attention on environmental performance at the supplier company. It does not address products or health and safety issues."(Andersen and Choong, 1997).

The common theme throughout all of the collaborative initiatives, which the RE supports, is one of an attempt to agree on a common format for the declarations and the development of a common system throughout the industry. This is essential for any system to operate with optimal efficiency. It is apparent, however, that collaborative efforts are notoriously protracted with common agreement difficult to achieve. It is suggested that the main reasons for the failure to reach an appropriate decision is due to the complexity of the issue, the varied requirements and practices of organisations and the simple lack of comprehension of the importance of the issues at a high level in the organisation. The experiences of the RE suggest that organisations participate in collaborative programmes but the representatives generally have research roles. Thus, for any agreement to be made the representative has to report back to individuals in their own organisation who can make a decision on behalf of the entire organisation. Any iterative process therefore, becomes extremely protracted.

The Body Shop

Not surprisingly, due to their high profile ethical and environmental market image, The Body Shop has a firmly established supplier evaluation process in place. The process consists of four layers or phases of assessment each with a questionnaire (Mayers, 1997). The first questionnaire asks closed questions relating to commitment to environmental policy, auditing, reports, staffing, environmental management systems, accreditation and proactive "green" initiatives. The second questionnaire asks more probing questions regarding environmental business management. The third focuses on transport, storage and warehousing. Finally, as part of the product LCA evaluation, suppliers are sent a detailed data acquisition sheet. This sheet covers information on the full life cycle of the product. The Body Shop's approach is very detailed and thorough. It could be considered advanced but reflects the image of the company and the size and nature of their product range.

B&Q

B&Q is another organisation with a high public profile and one that was targeted by environmental pressure groups in the early 1990s because of its tropical hardwood products. The B&Q response was to immediately put into place a supplier environmental audit and programmes to address the issues. Subsequently the B&Q approach to environmental supply chain management is recognised as a success. The interesting point to note is that it has been very prescriptive and demanding and included the setting of goals and milestones for suppliers to reach to maintain their business with B&Q. In 1995 the supplier environmental audit was integrated with quality evaluation in the QUEST initiative (B&Q, 1998). QUEST is an integrated supplier assessment procedure looking at the Quality, Ethics and SafeTy of the supply base. Suppliers are awarded one of five grades (A to E) in five different aspects of their environmental programme that reflect B&Q priorities. The aspects are: Environmental Policy and Awareness; Environmental Action and Achievements; Working Conditions in Developing Countries; Packaging and Environmental Claims; and Timber. There is increasing emphasis on product issues in the supplier evaluation process and now dedicated specialists are responsible for evaluating existing and new suppliers through interview and site audit for specific product ranges. In addition, B&Q are addressing supply chain issues beyond the environment and embracing corporate social responsibility - then next step for all organisations committed to vision of sustainability.

UK Government

The UK Government has a raft of guidance, policy and initiatives in place on "green procurement" to assist departments in incorporating environmental issues into purchasing decision-making. Much of this information has been driven by the government's commitment to sustainable development as described in the 1990 White Paper *This Common Inheritance* and the resulting model for greening operations within each government department. Core elements of the model include:

- Encouraging manufacturers, suppliers and contractors through specifications to develop environmentally preferable goods and services at competitive prices;
- Ensuring that any products derived from wildlife such as timber, plants and leather goods are from sustainable sources;
- Working with contractors to improve environmental performance where this is relevant to the contract and to the achievement of value for money (OGC-DEFRA, 2002).

Government departments are also required to comply with EC procurement directives on procurement and the UK Regulations that implement them.

Each government department has the flexibility to define it's own procedures for green procurement but the results are reported back to the green ministers and the nation.

Not only does the Department for Environment, Food and Rural Affairs and the Treasury provide guidance to government departments for integrating environmental performance into supply chain management but guidance is also provided for business organisations. A wealth of procurement information is available on the DEFRA Greening Government Operations web site: http://www.defra.gov.uk/environment/greening/gghome.htm

Throughout the 1990s the number of organisations involved in supply chain management has "grown from a few pioneers such as BT, B&Q, The Body Shop, IBM and Scott Ltd to a much more extensive listing. Those now involved cover both the private and public sectors, every size of organisation, every product range and service area."(Business in the Environment / The Chartered Institute of Purchase and Supply, 1997). This exemplifies the recognition of organisations of the supply chain being an integrated component of their environmental management systems and an area where dramatic improvements can be made. One resource that has been extremely useful to all organisations considering the issues surrounding the improvement of environmental performance in the supply chain is the Business in the Environment Buying into the Environment CD-ROM (BiE, 1994). Over 400 organisations contributed to the project (including Nortel Networks). The guidelines provide a wealth of information including case studies on the implementation of environmental supply chain management.

One theme that does emerge from all the work that has been conducted on supply chain management is the principle of partnership and collaboration throughout the chain. Crosbie and Knight (1995), Sarkis (1995), Beckman et al (1995), Whitaker (1995) and Green et al (1998) all emphasise the importance of partnership and the development of long-term strategic relationships between customer and supplier. However, this approach may, paradoxically, actually strangle innovation and improved environmental performance initiatives:

> "..while a firm may foster environmental collaboration by long-term, stable relationships, it may also blunt the ability to use market mechanisms (principally the

threat of substitution) to persuade suppliers to innovate or increase environmental performance." (Green et al, 1998).

The key perhaps, is to adopt a competitive selective strategy for suppliers of certain, off-the-shelf commodities and a partnership strategy that includes the sharing of technology roadmaps for specialist commodities.

In addition to the material summarised in the case studies there is also a vast range of company and industry group supplier assessment, requirements and specifications publicly available including a huge range of restricted/banned substance lists. Details of those used in the research project are discussed in Chapters five, six and seven.

4.4 Customer Request Response

One of the objectives of the research project is to develop an information management method that will assist in the provision of product environmental data to meet customer requests for information. At the start of the project no formal system for answering the environmental information requests of customers of Nortel Networks was in place. A web-based "Environmental Toolkit" has now been developed within Nortel Networks that provides generic answers to commonly asked questions from customers. It is envisaged that supplier component information could be integrated into the toolkit and also the EPOA to provide customers with detailed product information. Details of customer requests are provided in Chapter five. Hewlett Packard, Sun Microsystems and IBM Corporation have published case studies on the development of customer response systems. The RE's comments on each case study are provided.

4.4.1 The Hewlett Packard (HP) Approach

The case study provides an indication of the current demands placed upon manufacturers of electronics products by customers. HP are receiving an increasing number of requests for increasingly more detailed environmental information. HP have responded to the challenge by developing a specific approach. The approach involves working with selected customers to determine what environmental information is generally required by customers for decision-making purposes. The mechanisms for the provision of the environmental information are not described in the case study. However, the provision of product and process environmental information will have to include the capture of information from the supply base. HP are keen to develop a standard acceptable declaration in order to avoid any need to generate a customised response to customer requests. It is questionable though whether it will be acceptable to all customers and whether supplier data will be available.

4.4.2 The Sun Microsystems Approach

The case study describes the Sun Microsystem strategy for responding to the increasing number of customer requests. Rather than engaging in direct dialogue with customers, Sun systematically logged all the questions present in each customer questionnaire and set out to provide the information for all topics mentioned twice (80% of the total requested information) and place the information on a web site to make it available to the sales teams. Sun do not describe in detail what information would be posted on the web site. It is likely that some customers ask for specific material composition of products. It is not known whether Sun provide or intend to provide product environmental data for customers on all products. If they do, some process must be in place to capture the data from the supply base.

4.4.3 The IBM Corporation Approach

IBM have developed a corporate-wide product environmental profile system utilising Lotus Notes as for information management and document control. (Ching, et al, 1998). It is an integral component of the IBM Environmentally Conscious Product programme and the corporate certification to ISO 14001. The PEP documents environmental aspects covering the complete life cycle of the product, including materials selection, energy requirements during use, supplies and consumable items and disposal issues. The PEP is used as a checklist for design requirements, communicating information to customers and during end-of-life operations.

4.4.4 The Nortel Networks Approach

Nortel Networks has developed an Environmental Toolkit - a database of answers to commonly asked questions from customers. This enables customer-facing sales teams to answer the majority of questions from customers themselves without having to ask the corporate environment department. However, the answering of product-specific questions, particularly regarding material content and materials used during production, is problematic. Two research programmes conducted at Nortel Networks Harlow Laboratories in the UK resulted in an example Product Environmental Profile and an alpha 3-D virtual reality tool being tested. Both prototypes offered a means of presenting product environmental information to customers. Neither has been fully implemented. The problem is obtaining satisfactory material content and production-material use data.

The EICTA TR-70 Report could be used as a method of conveying product environmental information to customers. It is, however, limited in terms of providing material content information. Ecolabel schemes such as the Blue Label or Nordic Swan are becoming prevalent for consumer products but no such labels currently exist for telecommunications products.

4.5 Conclusions

The research project is problem-orientated. The research question being: "Can Supplier product Environmental Data be Integrated into the Ecodesign and Product Life Cycle Management Systems of Nortel Networks and Telecommunications Companies. This chapter has provided an overview of the work that already exists as a pool of knowledge in the relevant areas of research that are directly relevant to the generation of a solution to the research question. These areas are ecodesign, environmental supply chain evaluation and customer communication.

It is clear that the ecodesign programme at Nortel Networks is less advanced than some of the organisations presented as leading edge practitioners in this Chapter. Despite the progress that has been made there still appears to be a lack of commitment and a clear business case to enable deployment. Clear advantages can be seen from successful implementation. It remains perplexing that telecommunications in general struggle to see the value of ecodesign. This situation will change dramatically with the introduction of product-focussed legislation from the European Union.

This Chapter has highlighted some interesting and established programmes for supply chain management and customer communication throughout the electronics industry and indeed other sectors. Nortel are in a similar position in these important areas as they are for ecodesign. Again, there appears to be some opposition to the roll out of these programmes as clear business reasons for doing so do not appear to be evident.

The work completed in this EngD research project will add weight to the argument for the complete implementation of Product Life Cycle Management solutions.

Other important areas such as legislative requirements, customer requirements and information for continual improvement for ISO 14001 are covered in Chapters five and eight in particular as they form a significant component of the research programme.

A vast quantity of work has been complete in this field but no solution as yet is readily available for telecommunications equipment manufacturers. The EngD research project investigates the issues and provides solutions to the problem.

Chapter 5 Data Requirements

The objectives of this chapter are to:

- Provide details of the work conducted in Programme 1 of the research project; and
- Detail the information that needs to be obtained from suppliers to meet the requirements of ecodesign, legislation, customer requests and ISO 14001.

5.1 Introduction

The research project is driven by a top-level research question and the research is divided into three packages of work as described in Chapter 3. The hypothesis is supplier product and company environmental data can be integrated into the ecodesign and Product Life Cycle Management (PLCM) systems of Nortel Networks or any telecommunications network solutions company. Programme 1 of the research project focused on activities designed to determine the information that needs to be obtained from suppliers to meet the requirements of ecodesign, legislation, customer requests and ISO 14001 and therefore, to advance PLCM.

In this chapter the main activities are described and the results are presented. Details of specific planned activities conducted in programme 1 can be found in the six-month reports.

5.2 Customer Environmental Information Requirements

In terms of meeting the environmental information requirements of customers and particularly the product environmental information requests in customer environmental questionnaires it is suggested that only detailed component-specific supplier-specific data will suffice. Using generic averaged data on representative components is not considered to provide the necessary degree of accuracy and certainty.

To identify the product environmental information requirements of customers the data from two research tasks were used:

i) Tabulated customer requests/proposals for contract bids;

ii) Detailed analysis of selected customer environmental questionnaires.

In addition, further work was conducted on the development of a questionnaire for customers of Nortel Networks to investigate exactly how customers used the information requested and whether it did actually influence their decision to approve and award a bid for contract (Appendix II). Unfortunately, due to strategic decision-making within Nortel Networks this questionnaire was not given approval for use.

The Nortel Networks Corporate Environmental Services group has a programme in place to tabulate customer requests for environmental information. It is not possible to include this information in this thesis as it is considered proprietary. However, two things are readily apparent from viewing the data:

- It can be seen that the customer environmental requirements or requests for information vary considerably; and
- To varying degrees customers have inquired about the environmental performance of Nortel Networks in fifty-five contract bids over 21 months (1998 – 1999), worth US$ 8 billion (known bid values only). This compares to the previous 28 months (September 1995 – December 1997) with twenty-four contract bids worth US$561 million.

A selection of customer questionnaires received prior to December 1997 were analysed to determine more specific detailed customer requirements and were also used in a gap analysis. The selected customer questionnaires can be seen in Appendix III.

5.2.1 Gap Analysis

5.2.1.1 Introduction

"In 1995 and 1996, less than five customer inquiries a year required responses by Nortel Networks' Environment and Sustainability (Corporate Environmental Services). In 1997, the number exceeded 25"(Nortel Networks, 1998).

Not only are Nortel Networks receiving an increasing number of customer requests for environmental information as part of the bid process, but the requests are also increasing in the level of detail and the quantity of information required.

The provision of detailed product environmental information can only be achieved by Nortel Networks requesting the information from the supply base and establishing systems to transfer the information through the company and on to customers. This means that any Nortel Networks supplier environmental assessment questionnaire must be focused on providing information requested by customers and providing information for ISO 14001, ecodesign and meeting the requirements of relevant legislation.

This gap analysis was conducted on customer environmental assessment questionnaires and Nortel Networks supplier environmental assessment questionnaires.

The objectives of the gap analysis were:

- To determine customer environmental information requirements;
- to compare the environmental questions asked of Nortel Networks by a selection of customers with those asked by Nortel Networks of its suppliers;
- to identify the differences that may exist between the two sets of questionnaires (the gap); and
- to suggest recommendations and next steps.

The scope of the gap analysis focused on the determination of the existing capability of Nortel Networks supplier assessment procedures in providing environmental information requested by customers. It is recognised that only a percentage of the information requested by customers of Nortel Networks can be provided by the suppliers of Nortel Networks (approximately 80%). The remainder can only be provided by Nortel Networks as it concerns specific company activities such as environmental policy and the environmental management system.

The gap analysis did not consider the existing capability of Nortel Networks supplier assessment procedures in providing environmental information for recognised material declaration programmes such as ECMA TR70 (Appendix IV). Neither did it consider the existing capability of Nortel Networks supplier assessment procedures in comparison with competitors.

However, the main recommendation of the gap analysis (the development of a new supplier environmental assessment questionnaire and information retrieval system), does consider the requirements of ECMA TR70, the Waste from Electrical and Electronic Equipment (WEEE) Directive and competitor benchmarking, in addition to the requirements of customers, ecodesign and ISO 14001. The aim is to maximise the flow of environmental information of value from the supply chain and its use.

5.2.1.2 Background

Environmental assessment questionnaires received by all Lines of Business from customers such as Telia, Bell Canada and Unisource Belgium demonstrate the detailed information customers require and indicate how the information is used. These customers request highly detailed product environmental information as well as asking long-established questions concerning company policy and environmental management systems. Questions about product energy consumption, design and construction, material content (with a strong emphasis on hazardous material content), packaging and take-back are being asked. Unisource Belgium actually required a signed declaration of the presence of certain specified hazardous substances in the product to be supplied. BT have minimum environmental requirements that suppliers have to meet. Bell Canada express specifically that:

> "Potential suppliers should recognise that their (environmental performance) score will be one consideration in the supplier selection process, along with price, delivery time, performance, quality and other factors. This question reinforces our position that suppliers can gain competitive advantage by demonstrating the superior environmental performance of their operations, and their products and services." (Bell Canada Supply Services, 1996).

At present, Nortel Networks is not in a position to state accurately the material content of its products to customers because the information is not available within Nortel Networks' design and manufacturing systems.

This results in Nortel Networks either declaring that they do not know what is in the product or signing a declaration that certain hazardous substances are not present in the product to the best of their knowledge. This could result in non-compliance with customers' specifications that could result in possible legal action.

5.2.1.3 Gap Analysis Method

A gap analysis is a simple procedure designed to expose the differences between defined parameters. In this case the parameters are the Nortel Networks customer environmental assessment questionnaires and the Nortel Networks supplier environmental assessment questionnaires. To enable direct comparisons to be made and interpreted a structured method was needed for the analysis. In this case the method consisted of six stages:

1. Identify and determine the parameters;
2. Determine the method of comparison;
3. Conduct preliminary analysis and generate results;
4. Develop an advanced method of comparison;
5. Conduct secondary analysis and generate results; and
6. Interpret the results.

The six stages are described in detail below.

Identify and determine the parameters

All available customer questionnaires and inquiries were collected. This process was aided by work already conducted by Nortel Networks Corporate Environmental Services that included a collated list of customer environmental requests between 1995 and 1997. The eleven most comprehensive questionnaires were identified for the analysis (see Table 6).

All available supplier environmental assessment questionnaires generated within Nortel Networks were collected (one at corporate level (180.65), one at UK site level (Environmental Toolkit), one at a specific function level (Mechanical Capability) and five at site level (developed for ISO 14001)). All eight questionnaires were selected for analysis (see Table 6).

Table 6. List of Questionnaires Used in the Study

Customer Questionnaires
Telia
British Telecom
Unisource
Telecom Eireann
Swedish Railways
Bell Canada
Statskontoret
Mitsubishi Electric Co. Ltd
Cable and Wireless
Ministry of Defence
Bell South
Nortel Networks Questionnaires
Matra Communication
Environmental Toolkit (see appendix V)
Corporate Standard 180.65
Cwmcarn
Monkstown
Mechanical Supplier Capability
Cogent Defence Systems
Paignton

Determine the method of comparison

The Telia questionnaire was taken as a customer benchmark standard because it was considered to be the most advanced, detailed and comprehensive questionnaire received from customers (see Appendix III). Each question on the Telia questionnaire was input into an Excel spreadsheet arranged by category (e.g. management system, policy, manufacturing) as in the Telia questionnaire.

The questions from each individual customer and Nortel Networks questionnaires were then compared to those in the list. If a question being assessed was considered to be identical to one already on the list it was ignored (e.g. The question: Are eco-revisions performed at your company? was considered to be the same as: Does the company undertake regular environmental audits of all its manufacturing sites?) If a question being assessed was considered to be different to any already on the list it was added to the list. This process was repeated for every question on each of the questionnaires. A list of the final set of questions is provided in Appendix V and the spreadsheet in Appendix VI.

Conduct preliminary analysis and generate results

A preliminary analysis was conducted by comparing the questions in each questionnaire with the final set of questions. One point was allocated to the questionnaire being evaluated for every question that was present in the final set. A total score was then generated for each questionnaire. The scores for every questionnaire were entered into the spreadsheet. The results were presented in graphical format comparing the scores of customer questionnaires with the Nortel supplier environmental assessment questionnaires and comparing the scores for the Telia and the Environmental Toolkit questionnaires by questionnaire sub-category (policy, management, manufacture etc..).

Develop an advanced method of comparison

The first method of comparison was based only on the number of questions in each questionnaire. The greater the number of questions in a questionnaire the higher the score attained. The number of questions in a questionnaire can be a direct indication of how comprehensive or effective it is. However, the quality of the question also needs to be taken into account. One comprehensive and focused question in one questionnaire could demand the same answer as ten in another questionnaire. To enable the effect of these "combination" questions to be incorporated in the comparison exercise it was necessary to develop and apply a weighting system.

The system consists of the application of seven factors to the score for every question in each questionnaire (the factors are presented in Table 7). The factors were chosen as being indicative in combination of the quality of a question for a supplier environmental assessment questionnaire. The magnitude of each applied factor was determined by assessing every question in respect to each factor and a score from one to five being allocated according to the question's potential performance in each area (1 = poor, 5 = good).

Table 7. Weighting Factors Used in Score Calculation

Weighting Factors (Scored 1 – 5)
Risk Management
Hazard Reduction
Question Coverage
Commonality
Nortel Significance
Customer Significance
Environmental Significance

Conduct secondary analysis and generate results

In the secondary analysis the factored scores for each question were then multiplied by the scores attained in the preliminary analysis for every question in each questionnaire. The total scores for each questionnaire and the sub-categories were calculated. The results are provided in section 5.1.1.3.

Interpret the results

The final stage of the gap analysis requires interpretation of the results and the generation of recommendations.

5.2.1.4 Results

The total number of questions in the final set is 138 (see Appendix V).

Using the weighting factors the maximum score attainable for each question is 35 (seven weighting factors x maximum question score of five).

If a questionnaire contained every question in the base set (not actually possible) the maximum it could score would be 4830 (138 x 35).

Figure 8 shows the comparative scores for the customer questionnaires and Nortel Networks supplier environmental assessment questionnaires.

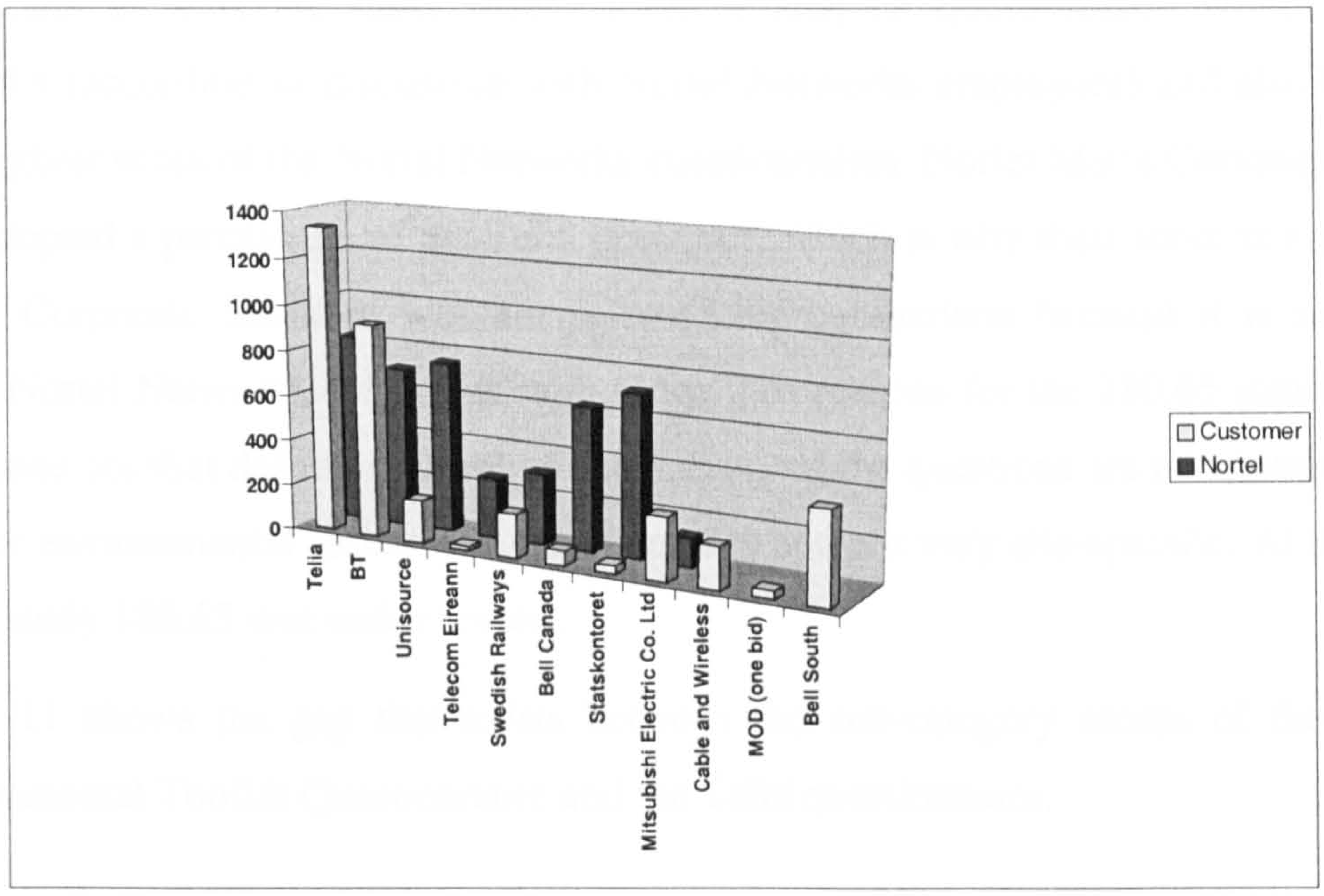


Figure 8. Comparative Performance Scores of Customer Questionnaires and Nortel Networks Supplier Environmental Assessment Questionnaires

Figure 9 shows the comparative scores for the named Nortel Networks supplier environmental assessment questionnaires against the Telia score that is the highest of all the questionnaires.

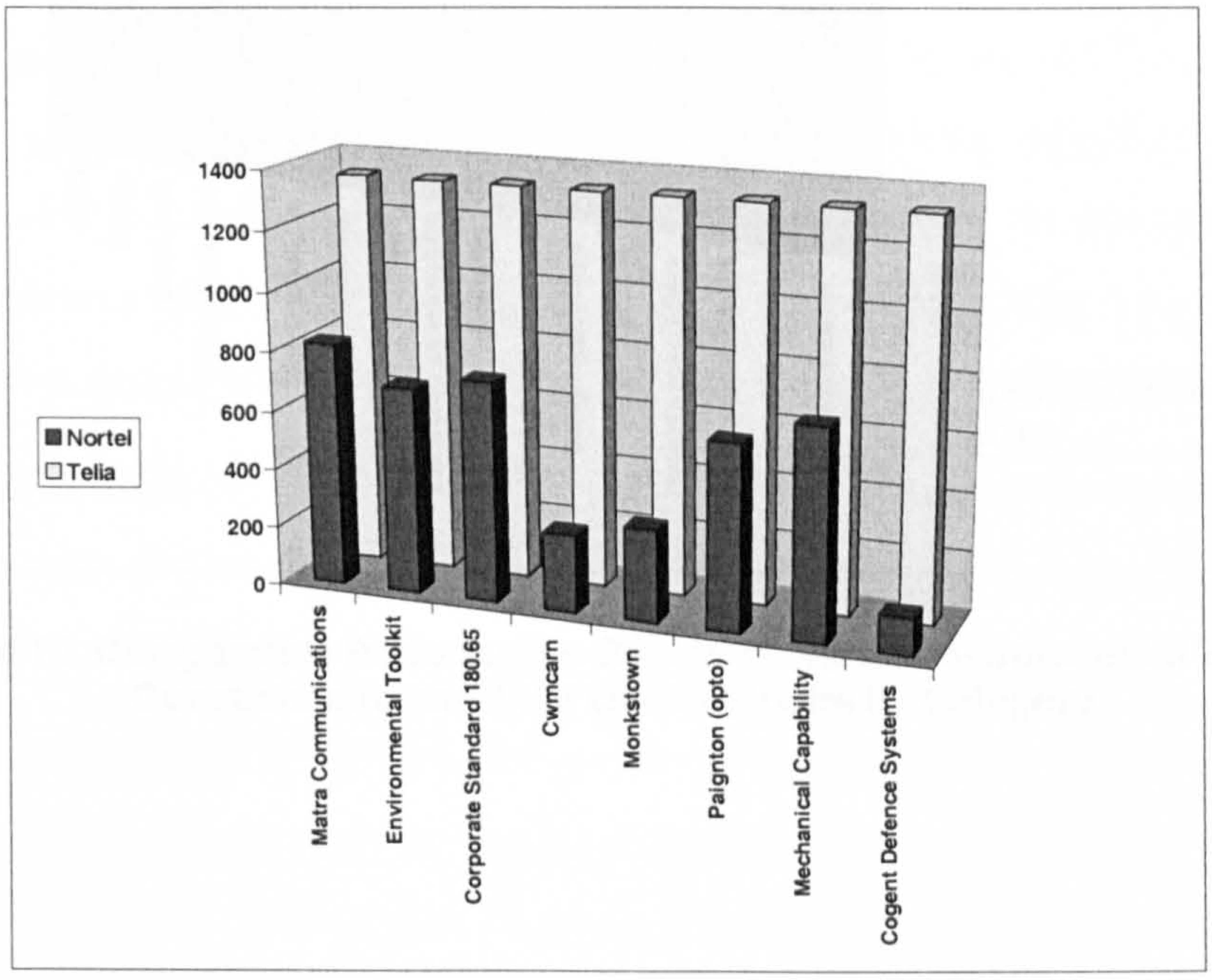


Figure 9. Comparative Performance Scores of Nortel Supplier Environmental Assessment Questionnaires and Telia Questionnaire.

Figure 10 shows the sub-category scores for Telia and the Nortel Environmental Toolkit Questionnaire (see Appendix VII). The Toolkit questionnaire was chosen for comparison as it is the most widely used or adapted questionnaire within Nortel Networks (according to discussion with Nortel Networks employees) and also has the third highest score of the Nortel Networks questionnaires. Nortel Matra Communication have adopted a percentage of the Telia questions, which is why their score is high. The 180.65 Corporate Standard was not selected for comparison because it is not used within Nortel Networks despite its high score. The reasons for the 180.65 standard not being used are that despite its level of detail many of the questions are not suitable for a supplier environmental assessment questionnaire and are very site-specific. At the time of this study 180.65 was under review.

Figure 11 shows the gap that exists between the sub-category scores of the Nortel Environmental Toolkit Questionnaire and the Telia questionnaire.

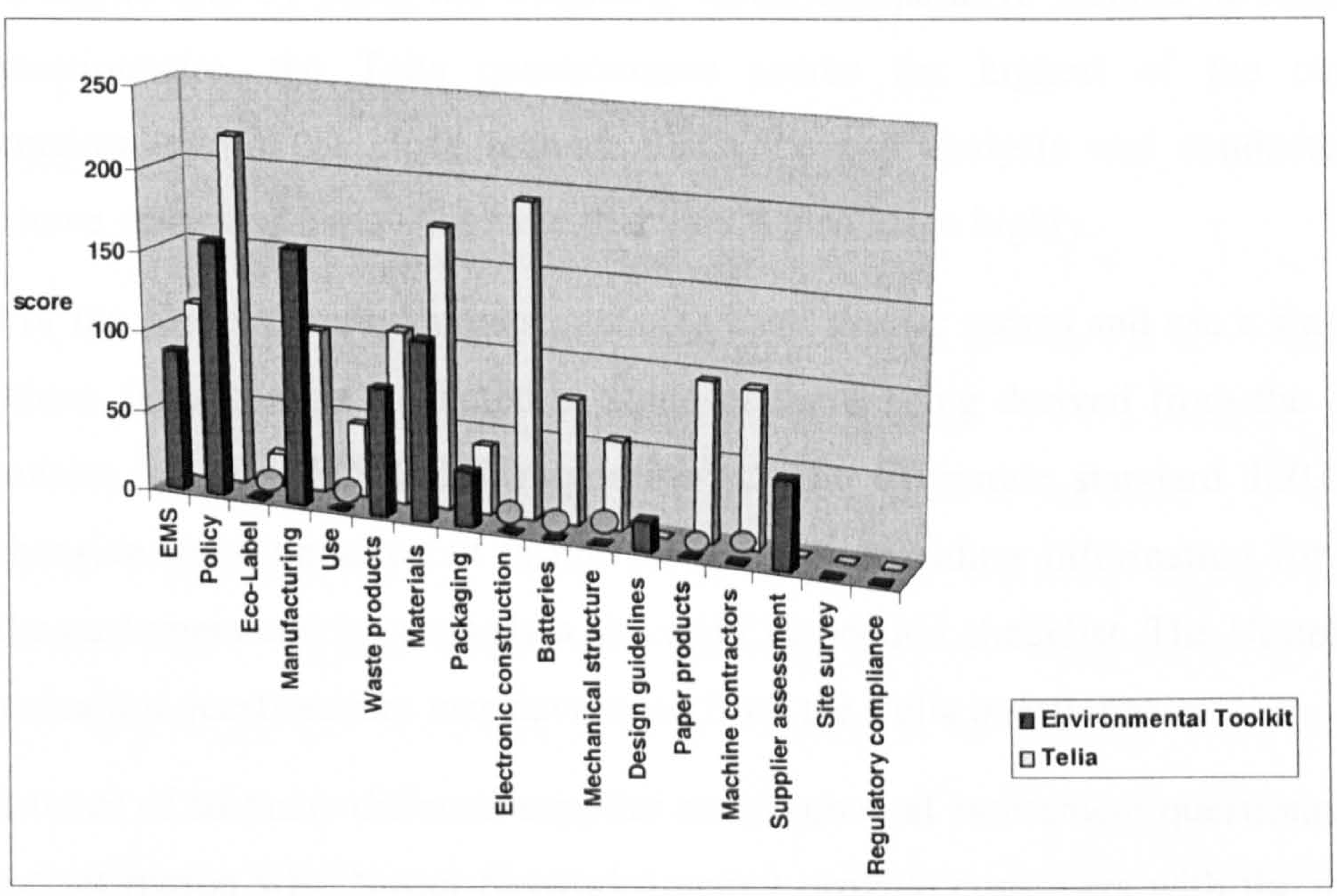


Figure 10. Comparative Performance Scores of Nortel Environmental Toolkit Questionnaire and Telia Questionnaire by Category

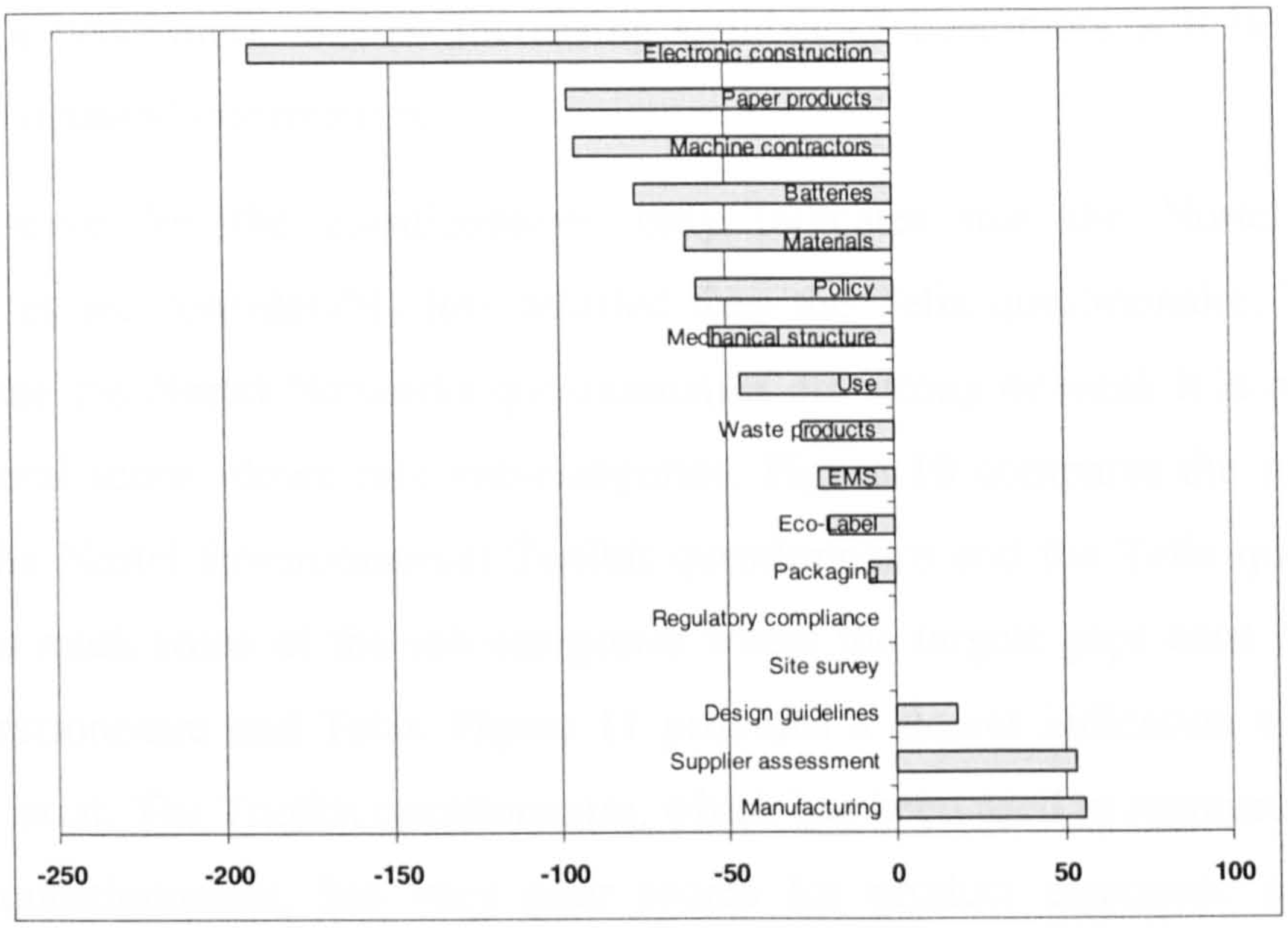


Figure 11. Performance Gap for Nortel Environmental Performance Questionnaire Compared to Telia Questionnaire

5.2.1.5 Discussion

Figure 8 shows that by using the weighting factor comparative method of scoring for each questionnaire, the Telia questionnaire scores the highest of the customer questionnaires with BT a close second. Since the gap analysis was conducted Bell Canada have generated a questionnaire that would also score highly.

Several of the Nortel Networks questionnaires have similar scores and use a similar set of questions. This can be attributed to some of them being derived from the Toolkit questionnaire for site ISO 14001 requirements. The Corporate standard 180.65 is a comprehensive questionnaire but is not focused on providing information for Nortel Networks customers and is primarily a site audit inspection checklist. The Nortel Matra Communication questionnaire was developed from the Telia questionnaire.

The existence of so many different supplier environmental assessment questionnaires is an important reason why Nortel Networks cannot provide customers with the required product environmental data.

Figure 9 illustrates how all Nortel Networks questionnaires have significantly lower scores than the Telia questionnaire. The four highest scores range between fifty-two and sixty two percent of the Telia score. They do, however, compare favourably with some of the other customer questionnaire scores. Nevertheless, the Telia questionnaire is considered a benchmark and an increasing number of customers will be requesting similar very detailed information.

The total score for the questionnaires only indicates that the Nortel Networks questionnaires are considerably less detailed than the Telia questionnaire. To identify exactly where the Nortel Networks questionnaires are strong or weak it is necessary to break the total scores down into sub-categories. Figure 10 compares the sub-category scores of the Nortel Environmental Toolkit questionnaire and the Telia questionnaire. The ellipses mark some of the sub-categories where the largest gaps exist between the Toolkit questionnaire and Telia. Figure 11 provides a clearer indication of where the major gaps exist. The Toolkit questionnaire, which has been used to represent the Nortel Networks questionnaires, has very poor scores for product electronic construction, materials, mechanical structure, use and batteries. The Toolkit questionnaire also scores poorly on paper products and machine contractors (see Appendix V sections D and E for these category questions).

Figures 10 and 11 clearly show that the 1997 Nortel supplier environmental assessment questionnaires were not focused on providing information to meet customer requirements.

The study has enabled customer requirements to be clearly identified. It is also evident that customers' interest in their suppliers' environmental activities are moving beyond simple questions concerning the presence and implementation of environmental policies and management systems to specific product environmental performance. It is also clear that many of the product specific questions asked of Nortel Networks by customers can only be answered comprehensively by asking suppliers of Nortel Networks similar questions. At the time this study was conducted it was shown that the Nortel Networks supplier environmental assessment questionnaires did not contain detailed questions about the product. It is clear that a new and improved version needed to be developed.

5.2.1.6 Conclusions

The gap analysis shows the Nortel Networks supplier environmental assessment questionnaires in 1997 were not focused on obtaining the product environmental information from the supply base that is being requested by customers.

Several customers are using environmental performance as one criterion in their supplier selection process. Nortel Networks was in a weak position to answer many of the detailed questions asked by customers. Some customers are stating specific environmental performance requirements that Nortel Networks cannot meet because of the lack of information on the material composition of the products of Nortel Networks. This situation is apparent from the results of the gap analysis. Nortel Networks do not request product specific environmental data from suppliers and there is no system in place to convey such information to those answering customer requests. This means Nortel Networks do not know the material composition of their products.

5.2.1.7 Recommendations

The recommended next step from the gap analysis was to use the information on customer requirements to generate a new Nortel Networks supplier environmental assessment questionnaire that is focused on providing information for customer requests, ecodesign, PLCM, ISO 14001 continual improvement loops, ECMA declarations and meeting the requirements of the proposed WEEE Directive. The questionnaire also needed to be adopted at a corporate level to ensure the information can be of benefit to the entire corporation.

A new process for supplier environmental appraisal was developed in programme 2 and is detailed in chapter 6.

5.3 Design Requirements for Component Eco-Selection

The aim of this activity was to identify the appropriate product environmental information that could be obtained from suppliers, in theory, that would assist the ecodesign process through the component selection procedure. Initial discussions took place with individuals responsible for the ecodesign implementation programme and selected mechanical and electrical designers. The "interviews" were deliberately unstructured to enable a free flow of discussion between the RE and the designer. Six designers (three mechanical and three electrical) were interviewed. The discussions centred on the designer's views and impressions of how they could use material information in the design process. Legislation was only mentioned and did not involve detailed discussion. Only potentially banned materials were specifically discussed.

One immediately identifiable problem was that at the start of the research project there were no design groups within Nortel that were actively engaged in ecodesign as a formal component of the product development process. An ecodesign tool was in the latter stages of development and the training of some design groups had taken place.

One of the ecodesign strategies that can be selected in the tool is "avoidance of hazardous materials", a common ecodesign practice. It was hypothesised that certain materials could not be avoided without the knowledge of their presence in components or materials being made available. Other ecodesign material selection options such as recycled content and recyclability could also not be used to their full potential without the availability of appropriate product information.

It is proposed that if component material and environmental information were made available through the supply chain it could be used in the ecodesign material selection procedure. This would mean a decision being made in terms of environmental performance during design, component qualification or manufacturing procurement.

Discussions with electronic hardware designers suggests that design groups would prefer any environmental consideration in component selection to be taken into account at the component qualification stage as the designer's overriding concern in electronic hardware design is that of functionality.

The incorporation of environmental concerns into the component and material selection decision-making process would require a quick and simple eco-evaluation tool to be available to component qualifiers and manufacturing procurers. The development of a methodology for eco-evaluation of components for ecodesign or PLCM and when it could be used was an activity in programme 3 and is detailed in Chapter 7.

The data required or utilised for component selection and ecodesign decision-making could range from generic hazardous material declarations (both positive and negative) through complete material composition to full life cycle inventory data. A study was conducted to compare existing product environmental data sources with supplier programmes. Details are provided in Chapter 6 and in the research papers in C-2 of the portfolio.

5.4 Identification of Product Environmental Legislative Requirements

The aim of this activity was to ensure that any product information potentially obtainable from the supply chain that would assist in meeting the requirements of product environmental legislation, was identified to enable appropriate action to be taken. This would enable compliance with existing and pending legislation that impact on Nortel Networks products. It is suggested that legislative requirements should be considered in material and component selection and technology road-mapping (forecast technology development).

A centralised environmental legislation tracking system has been implemented by the Corporate Environmental Services group at Nortel Networks. This is to ensure the company is aware of its legal requirements and the development of pending relevant impacting legislation. The majority of the relevant legislation concerns the banning or restriction of hazardous materials in products or the management of products at end-of-life.

Asking a supplier whether they comply with legislation or requesting that they comply is common in supplier environmental assessment processes. However, this strategy does not provide the company with assurance that the supplier and their products will be compliant with any pending legislation such as material bans, or that their products do not contain materials of concern to customers and society as a whole that are not banned or earmarked for ban. Neither does it indicate what the supplying company is, or could be doing, regarding product environmental performance improvement such as developing materials technology. Only the provision of some form of systematic product material declaration and the sharing of dialogue on environmental technology innovation can ensure current and pending legislation on product environmental performance is complied with.

Currently there are three core items of electronic-product-focused legislation emerging from the European Community Council and Parliament that are having, and will have, a big impact on the electronics industry. It should be noted that at the start of the project the WEEE Directive was in its infancy and 2nd draft stage. The RoHS Directive did not exist but was grafted off of the WEEE Directive and the original EEE Directive as a draft only appeared towards the end of the research project. The core focus for legislative requirements and the development of solutions therefore, was the WEEE Directive. Details of the three key items of legislation are provided here (note that each description has been updated to include the latest developments at the final proof reading stage of this document).

5.4.1 Directive of the European Parliament and of the Council on Waste Electrical and Electronic Equipment (EC, 2003a)

The WEEE Directive emerged from a European Parliament resolution on 14 November 1996 that asked the Commission to "present proposals for Directives on a number of priority waste streams including electrical and electronic waste, and to base such proposals on the principle of producer responsibility" (EC, 2003a).

The objective of the Directive is "as a first priority, the prevention of waste electrical and electronic equipment and, in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all economic operators involved in the life cycle of electrical and electronic equipment and in particular operators involved directly in the treatment of waste electrical and electronic equipment." (EC, 2003a).

The final version of the WEEE Directive was published in the Official Journal of the European Union on 13 February 2003.

The core requirements of the WEEE Directive as applicable to telecommunications companies such as Nortel Networks are:

- The collection of WEEE from customers;
- The transfer of WEEE to treatment facilities to allow appropriate treatment of WEEE in accordance with the technical requirements laid out in the Directive;
- The recovery of 75 percent of WEEE collected and component, material and substance re-use and recycling of 65 percent;
- Ensuring financing of the costs for collection, treatment, recovery and environmentally sound disposal of WEEE is provided by the producer;
- Provision of such information as is needed by treatment facilities to identify the different electrical and electronic equipment components and materials, and the location of dangerous preparations and substances in the equipment; and
- Member States shall encourage the design and production of electrical and electronic equipment, which take into account and facilitate dismantling and recovery, in particular the re-use and recycling of WEEE, their components and materials.

The Directive entered into force in February 2003. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with the Directive by 13 August 2004. The Directive underwent many revisions over a seven-year period. Nortel Networks along with many of its competitors and other electronics manufacturing organisations was involved in lobbying the European Parliament directly as well as working towards changing the requirements through industry groups. Implementation of the Directive will have a significant financial impact on Nortel Networks particularly in terms of collection, recovery and treatment of existing equipment that will be taken back at end-of-life. Some of the equipment on the market has a life span of twenty years and many contain hazardous materials that have to be treated. It is likely that Nortel Networks will join a collaborative programme for collection and recovery and it will be interesting to see how the industry manages the issue.

5.4.2 Directive of the European Parliament and of the Council on the Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment (EC, 2003b)

The RoHS Directive as it is commonly known was born out of the WEEE Directive and the principle emanates from the "Commission Communication of 30 July 1996 on the review of the Community strategy for waste management that stresses the need to reduce the content of hazardous substances in waste and points out the potential benefits of Community-wide rules limiting the presence of such substances in products and in production processes" (EC, 2003b).

The objectives of the RoHS Directive are to "approximate the laws of the Member States on the restrictions of the use of hazardous substances in electrical and electronic equipment and to contribute to the environmentally sound recovery and disposal of electrical and electronic equipment" (EC, 2003b).

The RoHS Directive came into force on 13 February 2003 when it was published in the Official Journal of the European Union.

The main requirement applicable to telecommunications companies such as Nortel Networks is:

- With effect from 1 July 2006 Member States shall ensure that "new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)" (EC, 2003b).

There is built-in scope in the legislation to allow for adaptation to scientific and technical progress and also to consider the banning of additional substances in the future.

The most interesting point of note is that "lead in solders for network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunication" (EC, 2003b) is exempted for the ban. In the first drafts of this legislation there was no such exemption. The industry had success in lobbying for the exemption on the grounds of operating safety. This is hugely significant for Nortel Networks as they will no longer have to move to the use of lead-free solders. However, the exemptions may cause further difficulties for the contract manufacturers supplying populated printed circuit boards to Nortel Networks and other telecommunications operators as effectively they will have to run multiple production lines for leaded and non-leaded solders. Further complications and costs may be encountered at the end-of-life stage for telecommunications products as the leaded solder will have to be treated and managed appropriately.

The only other issue for Nortel Networks is the use of hexavalent chromium as a coating. The development of an alternative coating was patented in 1999 based on molybdenum phosphate. It is plausible that this new coating could prove a satisfactory replacement.

The remaining substances to be banned are generally not used in Nortel Networks products. It is highly likely that other substances will be banned in the future. Beryllium is earmarked and this could cause significant problems for Nortel as it is used extensively in mechanical electromagnetic shielding in many products.

5.4.3 Proposed Directive of the European Parliament and of the Council on Ecodesign of Energy-Using Products (EUP)

This proposed Directive is now in it's third iteration. Formally the EEE, the proposed Directive was targeted at reducing the impact on the environment of electrical and electronic equipment. The second iteration focused on a framework for the ecodesign of end use equipment (the EUE Directive). The proposed EUP Directive is still in the inter-service consultation stage which means the full text is not available. The scope of the Directive though is still the ecodesign of electrical and electronic equipment including energy efficiency and it is possible the product ranges the Directive will cover may be extended to include aeronautical equipment and others.

An outline of the EUE Directive text is provided as it is likely this text will still provide the core of the proposed EUP Directive.

The scope of the Directive is to "ensure the free movement of end-use equipment within the internal market through the creation of a framework for the integration of environmental aspects in the design and development and for setting eco-design requirements for this equipment. It also establishes the conditions for the setting of specific eco-design requirements, as well as the methodology through which the level of these requirements is determined" (EC, 2002).

The EUE Directive, at the time of writing, sets out the following requirements for designers and manufacturers of electrical and electronic equipment:

- The manufacturer shall perform a conformity assessment of the EUE with the Relevant Requirements of the applicable implementing measure;
- The manufacturer shall issue a declaration of conformity and affix a CE marking of conformity to the products;
- Manufacturers of components or sub-assemblies will provide all necessary information to enable other manufacturers making use of the component or sub-assembly in EUE to establish the ecological profile of such equipment; and
- The product will be designed by applying essential requirements specified in the Directive. These essential requirements necessitate a life cycle approach and include an assessment of the environmental impact of the product design and the conveyance of appropriate environmental performance information to the user and end-of-life managers of the product. The designer is expected to achieve a balance in the selected design solution between environmental performance and other relevant considerations such as safety and health, technical requirements for functionality, quality and performance and economic aspects.

The EUP Directive will unquestionably set new legislative standards for the consideration of environmental issues in electronics product design and, for the first time, require producers of electrical and electronic products to consider product environmental performance as part of the legal conformance process for placing products on the market.

The implementation of the EUP Directive would result in a significant impact on Nortel Networks and telecommunications equipment manufacturers and particularly the design function. Data transfer throughout the supply chain would be required and the use of tools for formal environmental assessment of product life cycles.

5.4.4 Integrated Product Policy

A further significant step in the development of "greener" products and markets for such products is the drive towards a Community Integrated Product Policy (IPP). In 2001 the European Commission issued a green paper on IPP (EC, 2001b). This paper has since been withdrawn and is currently in inter-service consultation with the likelihood of the document being classified as a Communication. The Community IPP will be:

> "both a framework for Member States, local authorities, businesses and NGOs to develop their ideas and spread positive experiences on the greening of products and a driving force through specific Community initiatives where such initiatives are most promising. This will require that the different levels of action, the Community, national, regional and local levels, as well as government and business-led initiatives work hand in hand to ensure that a maximum effect of initiatives can be achieved" (EC2001b).

IPP is defined in the green paper as:

> "...an approach which seeks to reduce the life cycle environmental impacts of products from the mining of raw materials, to production, distribution, use, and waste management. The driving idea is integration of environmental impacts at each stage of the life cycle of the product is essential and should be reflected in decisions of stakeholders.
>
> IPP focuses on those decision points which strongly influence the life cycle environmental impacts of products and which offer potential for improvement, notably ecodesign of products, informed consumer choice, and the polluter pays principle in product prices" (EC, 2001b).

Adoption of a Community IPP could not only result in product related legislation but also other market-based instruments to achieve improved product/service environmental performance and a move towards sustainability. IPP offers all potential stakeholders an opportunity to shape future product focussed environmental initiatives.

5.4.5 Summary

The legislation tracking system within Nortel Networks will continue to identify issues particularly concerning substance bans as and when they arise. Compliance with existing international substance bans is not considered to be problematic. The three key items of existing and pending product-based legislation for the electronics industry, however, are potentially problematic. Each will require, at the least, knowledge of the hazardous materials present in electrical and electronic equipment and the EUP directive (proposed) will require complete material composition data from the supply chain for components and sub-assemblies.

5.5 Supply Chain Information Requirements for ISO 14001

Nortel Networks are committed to gaining certification to the ISO 14001 environmental management system standard at sites throughout the organisation.

Implementation of an environmental management system requires the identification of significant environmental aspects and impacts. All sites have different activities but at all sites the supply chain is recognised as indirectly contributing to the environmental aspects and impacts of the organisation. Therefore, supplier environmental assessment and management is considered an important element of the management system approach.

The environmental management system is a mechanism that provides for:

> "a systematic and cyclical process of continual improvement....... The cycle itself begins with planning for a desired outcome, implementing that plan, checking to see if the plan is working and finally correcting and improving the plan based on observations from the checking process. Logically then, if the original outcome desired remains the same, a system of this nature will, by default, generate increments of progress that continually move towards the desired outcome" (Roberts and Robinson, 1998).

For the supply chain of Nortel Networks the desired outcome is improved environmental performance of the suppliers in terms of overall environmental management aspects such as policy, systems and process improvements but also product aspects such as reduced hazardous material content or improved use-phase energy consumption). Such a desired outcome, therefore requires mechanisms for "doing, checking and reviewing".

Information is regularly gathered from suppliers on general environmental management aspects and environmental assessment questionnaires are common throughout the electronics industry. However, few companies have made active steps to capture comprehensive product data and integrate supplier product environmental issues into continual improvement programmes for ISO 14001.

Complete material data on components and sub-assemblies would enable Nortel Networks to conduct product eco-evaluations and to provide feedback to suppliers in a partnership approach in a bid to improve product environmental performance and thus, demonstrate continual improvement.

5.6 Summary

It has been shown that there are four areas within a product life cycle management approach for telecommunications equipment that have requirements for, or would benefit from, a range of product material or environmental data from the supply chain.

Customers are increasingly requesting hazardous material declarations and even complete material profiles of products.

The consideration of component and material eco-performance during product development or ecodesign requires accurate information on component material composition and the availability of life cycle inventory data could result in even more informed decisions.

To ensure continued compliance with existing, pending and new legislation, particularly on material bans, for electronic products requires knowledge of the hazardous materials present in the components and materials procured.

The provision of product material data and a commitment to substituting hazardous materials and improving product eco-performance by suppliers are regarded as factors that could be integrated into a continual improvement cycle for ISO 14001.

Chapter 6 Data Capture Solutions

The objectives of this chapter are to:

- Describe the methodology for data capture;
- Present the results and recommendations from this section of research (programme 2)

6.1 Introduction

In chapter 5 and programme 1 it was suggested that, in order to meet the requirements of customers, legislation, ecodesign and ISO 14001, a variety of data would need to be captured from the supply chain. Programme 2 of the research project was designed to identify how appropriate data could be transferred. The first step was to compare potential supplier product environmental data with alternative sources.

6.2 Data Solutions

A study was conducted to compare four solutions to the problem of product data capture:

- Database A - component life cycle inventory-based data used for DfE;
- Database B – component environmental specification data;
- Supplier Data – Nortel Networks specific; and
- Supplier Data – industry collaboration.

A simple evaluation of the four solutions in terms of their cost and effectiveness in resolving the data capture problem is illustrated in Figure 12

6.2.1 Data Capture and Availability Solutions Evaluation

Each of the four solutions were evaluated by asking the following questions:

1) Are the data the appropriate data (component specific material composition)?
2) How comprehensive are the data in terms of components covered?
3) Are the data easily available?
4) What are the costs of data capture?
5) Can the data be readily updated?

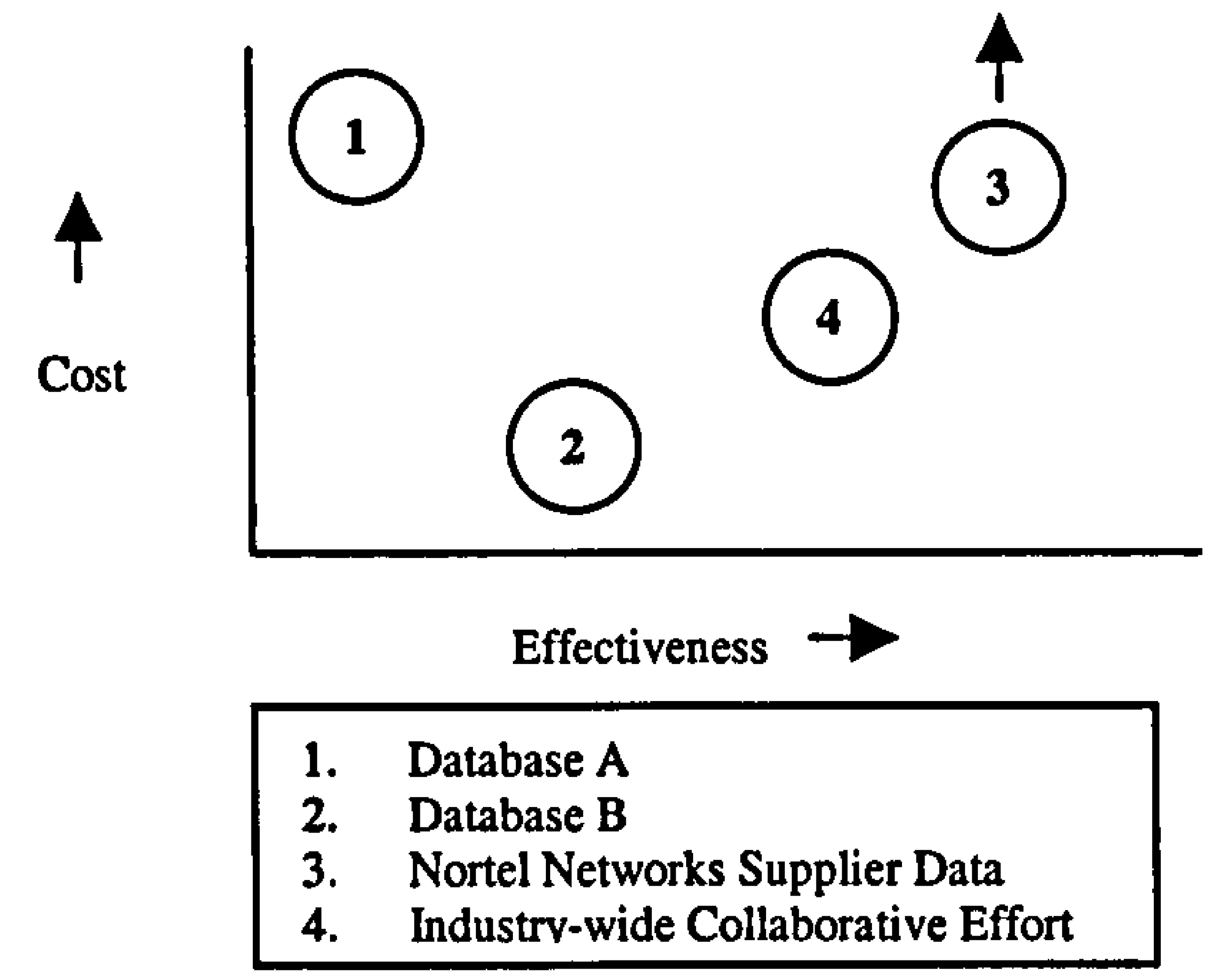


Figure 12. Basic Evaluation of the Four Solutions

For solutions 1 and 2 the components were selected because they were either identified as being a potential customer specification compliance issue or are just random examples of components.

A. Solution 1 - Database A

Database A is a commercially available database of components and materials used in the electronics industry. It is supplied as part of a Design for Environment software tool. The default categories for product data are: materials-in composition; Life Cycle Inventory (LCI) of raw materials; LCI of waste; LCI of air emissions; LCI of water emissions; additive materials in composition; and coating materials in composition. Table 8 shows the data available on selected components from the database.

The database, as supplied, contains a limited amount of data on a limited number of electronic components. Only some of the components have material composition data and component data are incomplete as Table 8 shows (• = present in database, X = not present). In addition, the data are not comprehensive in terms of components covered. The database is readily available as it is part of a DfE software tool but because of this the data are relatively expensive. It is clear that the data available would not provide the detailed component information required, primarily because the data provided in this version are only representative of a few electronic components. There is, however, a facility for expanding the supplier and component specific data in the database and the latest version of the software contains specific hazardous material data.

B. Solution 2 - Database B

Database B is a commercially available database that provides data on a selection of electronic components. The data are given in a different format to that in Database A. The environmental specification data are presented in four sections: identification; component technology (including a construction schematic and material balance (organic, metal and ceramic)); problematic substances and materials; and resource aspects concerning discarding. Table 9 shows the data available on selected components (• = present in database, X = not present).

Table 8. Example Component Data in Database A

	Material Composition	LCI of Raw Materials	LCI of waste	LCI of air emissions	LCI of water emissions	Additive materials in composite -on	Coating materials in composite -on	Non element-ary energy
Component I (Connector high current))	•	•	•	•	•	X	X	X
Component II (Connector low current)	X	X	X	X	X	X	X	X
Component III (Integrated circuit)	X	•	•	•	•	X	X	X
Component IV (diode - plastic body)	X	•	•	•	•	X	X	X

Database B contains detailed component material composition data, details of possible problematic substances and information on manufacture, assembly, disposal, and component recyclability data for a significant range of components. It also contains data on different types of components in the same family i.e. different specification capacitors. Data are available on a better selection of components than in Database A but the data still do not cover enough components or suppliers. However, the data on sample components have been taken from more than one supplier in some cases. The database is readily available at a low cost.

Table 9. Example Component Data in Database B

	Identification	Data Sheet	Constructio n Schematic	Materials Composition	Problematic Substances and Materials Data	Resource Aspects Concerning Discarding
Component I (transistor)	•	•	•	•	•	•
Component II (connector socket)	•	•	•	•	•	•
Component III (integrated circuit)	•	X	•	•	•	•
Component IV (aluminium electrolytic capacitor)	•	•	•	•	•	•

C. Solution 3 – Supplier Data (Nortel Networks specific)

Solution 3 involves capturing data from the suppliers of Nortel Networks. A programme was put in place to investigate this possibility. Details of the gap analysis conducted to identify whether the current Nortel Networks supplier environmental assessment questionnaires developed for ISO 14001 asked the type of questions that would generate the information to answer customer questionnaires are provided in Chapter 5. The conclusions were that they did not and that a new improved and advanced process was required.

Three new versions of a Nortel Networks supplier environmental assessment questionnaire were then developed utilising the information from research programme 1 that met the requirements of providing information for customers, WEEE Directive compliance, DfE, and ISO 14001 continual improvement. Each version of the questionnaire differed in format, structure and question content. Three suppliers were selected to participate in a pilot study. Each participating supplier was sent the three versions of the questionnaire in electronic format (Excel spreadsheet) and was asked to complete them in electronic format and to supply additional feedback. This included:

- comment on the ease of completion of the questionnaire in terms of an understanding of what was being asked and layout;
- rank the three versions from 1 (best) to 3 (worst); and
- comment on the ability of the supplier to provide environmental data on all products supplied to Nortel.

- Appendix VIII contains the trial questionnaires and covering letter (the latest version of the WEEE Directive and an example customer questionnaire were include in the pack sent to suppliers)).

The questionnaires consisted of sets of questions that are common to many supplier environmental assessment questionnaires, but each questionnaire also contained a specific detailed product environmental information section to complete. This product section requested material composition data at component level and data on materials used in manufacture and emitted during use of the product. The data form (see Appendix VIII) was designed to enable suppliers to declare a set of specific substances deemed "hazardous" by Nortel Networks (substances already subject to regulation, those earmarked for ban/substitution and those of concern to customers) and then to add others contained within the product. A declaration of as near to one hundred percent material content is preferable. The suppliers were asked to enter product material data into the data form if they answered that they could provide such data in the supplier assessment questionnaire.

The response to the research from the suppliers was positive. They all valued open dialogue with their customer on these environmental issues as they were rarely provided feedback on how the information captured in questionnaires was used.

A large amount of product information was requested through the product environmental questionnaires. Not surprisingly, the suppliers were initially surprised at the quantity and detail of data requested as no customer had actually requested detailed product information on all products supplied (thousands of components). They were, however, all prepared to provide as much information as they could and to develop collaborative programmes in an attempt to formulate a solution. The identification of the suppliers cannot be revealed but some feedback from the three suppliers is provided in Table 10.

The feedback from the suppliers suggests that only one of them is in a reasonably strong position to provide the product data requested (Supplier A has material composition data readily available on some components and is building its dataset). Two of the suppliers have generated a statement of generic composition (what is not in their products, what definitely is and what may be depending on customer performance requests). Figure 13 illustrates the "usefulness" of the type of data suppliers could provide and an indication of its availability. Hazardous material declaration meets some requirements but for Nortel Networks to be able to (1) answer every customers' request for hazardous material content (different customer/legislative lists), (2) select options for end-of-life (economic value of non-hazardous materials) and (3) drive towards the development of more environmentally friendly products, the data type has to move towards D in the diagram and the availability obviously has to increase.

Table 10. Supplier Feedback from Questionnaire Pilot Study 1

	A	B	C
EMS in place?	•	•	•
DFE programmes running?	•	•	X (planned)
Material composition data available on all products?	X	X	X
Material composition data available on some products?	•	•	•
Systems being developed to obtain product specific data?	•	X	X
General product material composition data available?	•	•	X
LCA data available on any products?	X	•	X

The next step was to select and finalise one of the questionnaires used in the first pilot study using feedback from the participating suppliers and feedback from groups within Nortel Networks. It was imperative that the new questionnaire (Supplier Environmental Appraisal Procedure) was considered for adoption or as a basis for a globally approved method for supplier environmental assessment and product data capture. Nortel Networks site Environment, Health and Safety primes provided input on the content, feasibility, ease of use and compatibility with the continual improvement process for ISO 14001, of the questionnaire. A scoring system was developed based upon expert allocation of scores to enable a quantified evaluation of the question responses. A second pilot study was designed. The product data form remained the same as for the first pilot. The questionnaire was sent to 26 suppliers of various commodities in an extended pilot study (see Figure 14 for final questionnaire). The comparative results for just the product data provision section of the questionnaire for each supplier is provided in Figure 15. The scores for each supplier are total scores from the data provision section that consists of four questions with scores allocated to each. The suppliers were asked whether the following were available:

- complete product material data;
- hazardous material content data;
- life cycle inventory data; and
- information on End of Life options.

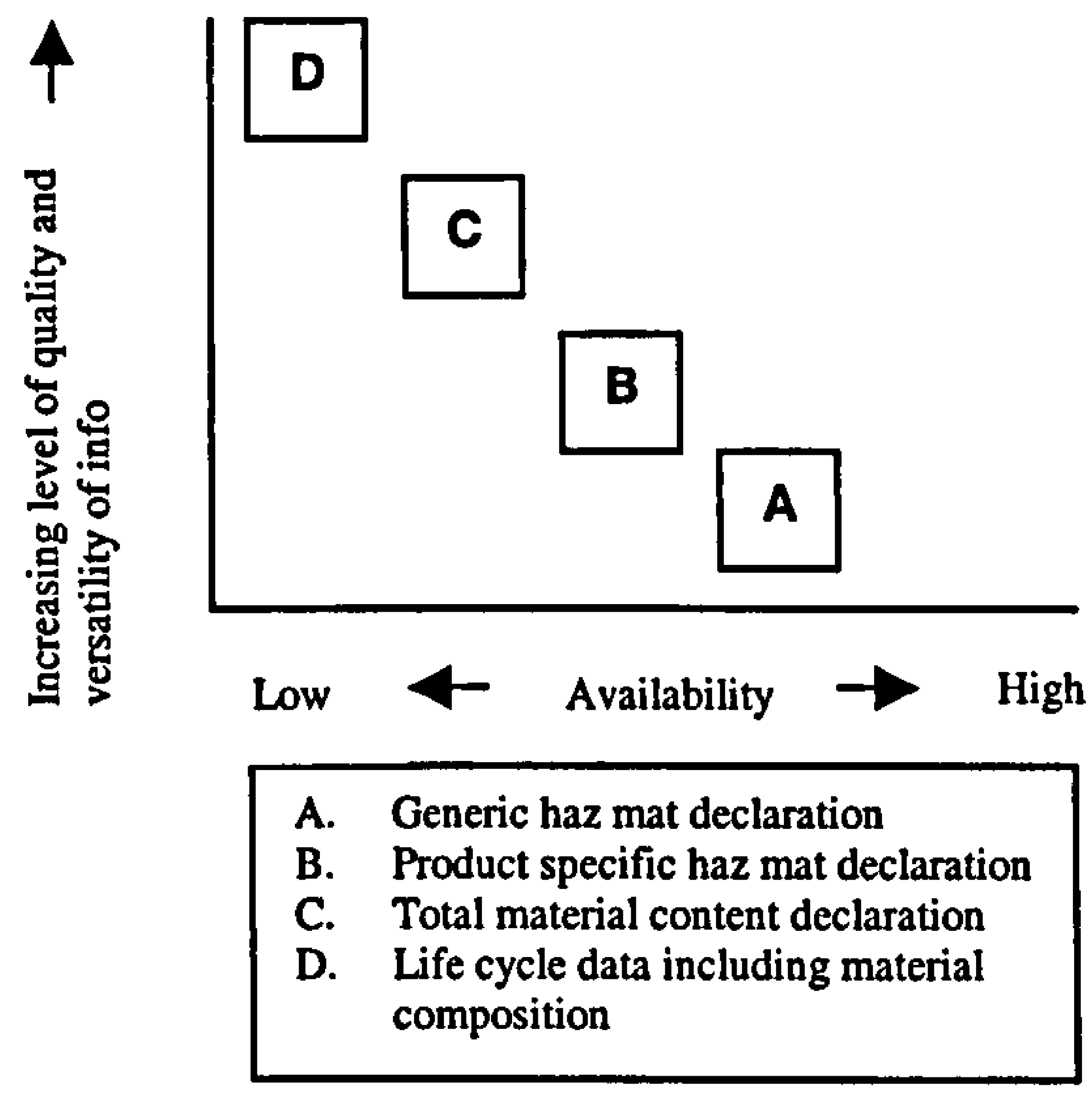


Figure 13. Data Usefulness and Availability

The majority of suppliers met the first target score. This is the score allocated for the provision of hazardous material content. Only two met the preferred score. Data on sample components (to be inserted into the product data form) were requested from each supplier. Only a few of the suppliers could provide data and much of the data were considered to be incomplete.

	New Nortel Networks Supplier Environmental Assessment Questionnaire					
	Confidentiality of Supplier's Information: The information requested and obtained from the supplier in support of this questionnaire and which is identified by the supplier as being of a sensitive or proprietary nature, shall remain confidential and shall not be disclosed to any party outside of Nortel Networks and its Subsidiaries. Where a Non-Disclosure Agreement exists between the supplier and Nortel Networks, then the terms of that agreement shall also apply.					
Name of Supplier:		**Date questionnaire completed**				
Address:						
Employee Name and position		**Tel Contact No.**			Score	
	Part A - Company Environmental Performance				Yes	No
1	**Environmental Policy**	Yes	No	Comments		
1.1	Does your company have an environmental policy supported by senior management?				10	0
2	**Environmental Management System (EMS)**	Yes	No	Comments		
2.1	Does your company have an EMS that is accredited to ISO 14001?				100	0
	If the answer to question 2.1 is yes go to Part B, if the answer is no please answer questions 2.2 - 2.10					
2.2	Does your company have an EMS?				5	0
2.3	Is your company seeking ISO 14001 accreditation?				5	0
2.4	Does the management system track developments in environmental regulations and relevant legislation?				5	0
2.5	Does the EMS include a waste management plan?				5	0
2.6	Does the EMS include a systematic approach to environmental improvement including the use of performance indicators?				5	0
2.7	Does the company have a system in place for assessing the environmental performance of suppliers of products?				5	0
2.8	Does the company have a system in place for assessing the environmental performance of suppliers of services?				5	0
2.9	Does the company consider environmental impacts associated with its transport function, i.e. delivery of products?				5	0
2.10	Has the company been prosecuted for environmental regulatory non-compliance?Details:				-10	10
	Part B Product Environmental Performance (for all products)					
1	**Section 1 Ecolabelling and Product Takeback**	Yes	No	Comments		
1.1	Is the product marked with any voluntary eco-labelling (if applicable)?				5	0
1.2	Does the company have a product takeback programme in place or is one being developed (please specify in comments section).				5	0
2	**Section 2 Manufacturing**					
2.1	Do the activities of your company require regulatory licensing?				0	5
2.2	Are hazardous materials as listed in Form A1 (tab below) used in the manufacturing of your products?				-20	20
2.3	Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? If you answered no to 2.2 above just answer no to this question.				20	0
3	**Section 3 Use**					
3.1	During the use of the product are any of the materials listed in Form A1 emitted?				-20	20
4	**Section 4 Eco-Design**					
4.1	Have any of the following eco-design strategies been used in the design process of the product?					
	Hazardous material avoidance (see section 5.2) in component structure, coatings.				5	0
	Re-usability				5	0
	Marking of plastics				5	0
	Recycled material content				5	0
	Recyclability				5	0
	Thermal convection reduction				5	0
	Disassembly				5	0
	Packaging minimisation				5	0
	Transportation packaging re-use (take-back)				5	0
	Transportation packaging recycled material content				5	0
	Avoidance of coatings and bleaches in transportation packaging				5	0
4.2	Does the company have or intend to have a formalised eco-design programme that is part of the product development process?				50	0
5	**Section 5 Product Environmental Information**	Yes	No	Comments		
	The answers to the following questions will provide Nortel Networks with an indication of the supplier's ability to provide detailed product environmental performance data. If the supplier answers yes to any of the questions, they are requested to use Form A1 for the provision of product material composition data, the indication of the use and phasing out of hazardous materials in the manufacturing process and emissions during use. LCA data should be provided in electronic format if available.					
5.1	Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete component materials declaration in Form A1)				70	0
5.2	If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are presently considered by Nortel Networks to be those on the list in Form A1.(Please complete the hazardous material declaration in Form A1 for each component)				30	0
5.3	Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel Networks? (Specify the products and provide the data in electronic format if available:)				20	0
5.4	Can the supplier provide guiding information on end-of-life options for the supplied products?				10	0
				MAX SCORE ATTAINABLE= 400		

Figure 14. Pilot Study 2 SEAP Questionnaire

The completed SEAP questionnaire from one supplier, the comparative scores from the pilot study for all sections of SEAP and one of the pilot study reports that were sent out to every participating supplier in the study are provided in Appendix IX. Every participating supplier received detailed feedback on their performance and how they compared to the other suppliers participating in the study.

The results from the second pilot study gave an excellent indication of the diversity in environmental performance of suppliers and the dearth of available product material content data and yielded an approach to supplier environmental assessment that was approved for use by the Nortel Networks European ISO 14001 site primes (Site Environment, Health and Safety representatives).

The pilot also yielded two crude tools – the SEAP questionnaire and the product data form. They are crude in the sense that they are spreadsheet-formatted documents. The next objective in the research project was to transform these basic forms into a proposed and demonstrable web-based system (see section 6.3).

D. Solution 4 – Supplier Data (Industry Collaboration)

The proposed solution 4 to the problem of data gathering involves direct capturing of product environmental data from suppliers but the workload is shared in a collaborative venture amongst electronic equipment manufacturers. Supplier environmental assessment would still be conducted by the individual companies but product data would be collected in collaboration. This would require co-operation and would need agreement particularly on the format in which the data should be provided and method standardisation. The costs of data capture should be reduced but the effectiveness may also be reduced because data obtained by one electronics company may not be suitable for another (see Figure 12).

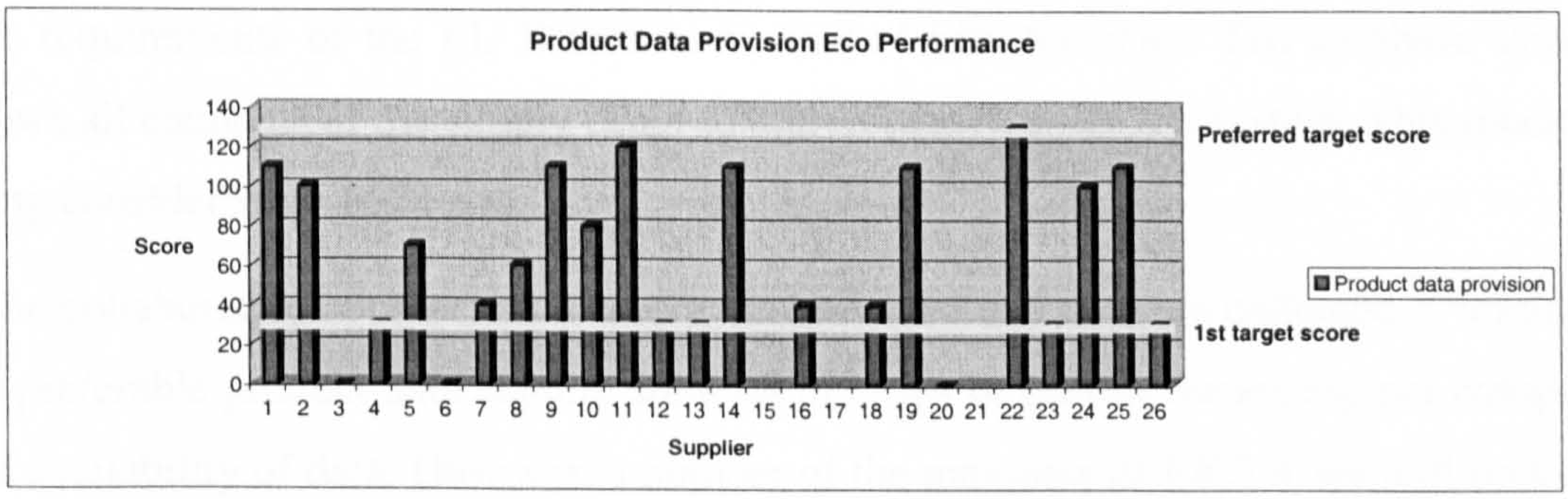


Figure 15. Supplier Product Data Provision Scores

At the time of the development of SEAP no such initiatives existed. However, in the last two years three such initiatives have emerged and are currently being developed. The most significant is the Supply Chain Management programme of EICTA (European Information and Communication Technology Industry Association.

The objectives of the initiative are to:

- Develop a common list of reportable materials;
- Set up a web site to link into suppliers accepted into the scheme;
- Require suppliers to display information on products on a standard template;
- Require suppliers to demonstrate they have an effective Environmental Management system in place;
- To expand the scope, once it has been established to include Life Cycle Assessment data;
- Have supplier approval by EICTA member companies;
- Prepare common training material for EICTA members to use with their suppliers; and
- Pilot to be launched within six months (Adams and Loch, 2000).

The RE has been representing Nortel Networks in this industry group initiative and at the time of writing the list or reportable materials and substances has been agreed, the format for declaration agreed for the pilot study and discussions concerning the database structure are taking place. The pilot study is imminent.

A similar initiative is already underway in the automotive industry. A database system (the International Material Data System (IMDS)) has been established to meet certain data requirements of the EU Directive on End-of-Life Vehicles. The database system allows all elements of the supply chain to add relevant data to the system. This model is being considered by EICTA.

If the collaborative approach is actually implemented and data are collected it would be the preferable product data capture solution in terms of cost of ownership per company and availability of data. However, a number of the members of EICTA are still opposed to the scheme and question the need for the capture of such detailed data.

Two other initiatives are also underway:

- Electronic Industries Alliance (EIA, USA); and
- Japanese Green Procurement Initiative

The EIA is a major electronics manufacturers trade association. Their work in this area has resulted in the generation of a common list of product reportable materials for their members to use when procuring from suppliers. The draft template (EIA, 2000) requires the declaration of the presence or not of a set of hazardous substances and also four "recyclable" metals and their compounds. The supplier is not expected to quantify those substances present.

The Japanese initiative is a recent development and very much at an embryonic stage with only some theories concerning material declarations being tabled. The Japanese working group recognise the extensive work already conducted by EICTA and are seeking to explore opportunities for alignment of effort.

The electronics industry obviously operates at a global level with many multi-national companies involved. It would be beneficial to the industry if a global approach to product material declarations could be brokered and a common process agreed.

It is the RE's opinion that only a collaborative approach to data capture will solve the problem and provide the necessary information at the appropriate cost. Obviously all participants have to be convinced that full-scale data capture on material content of components is the right thing to do. It is suggested that many organisations still question whether it is.

The recommendation is that organisations investigate their commitment whilst collaborating on the collection requirements associated with the WEEE Directive. If the EUP Directive or it's equivalent enters into force collaboration will surely be imperative.

Other collaborative data capture initiatives have also developed, of which GreenPack is the most notable. GreenPack is a Scandinavian initiative that is focussed on obtaining product material content data from electronics component suppliers primarily in Scandinavia. It is likely that this initiative will be integrated with the larger, more global programmes.

6.2.2 Data Capture Solutions Summary

The data source comparative study demonstrated that only supplier-specific data could meet the needs and requirements defined in chapter 5. The next stage of the research focused on developing and refining an appropriate solution for use by Nortel Networks and potentially other telecommunications companies.

6.3 Proposed Data Capture Solution

Capturing product material data for the supply chain for a company such as Nortel Networks can be achieved in two ways:

- Manual compilation, transfer and data input to database; and
- Internet-based entry, transfer and databasing.

The first method requires the supplier to enter the material data specific to a component with a unique part number into a template either by hand or in Excel or Word and then sending it to the customer either by post or e-mail (in the second SEAP pilot study the supplier was requested to complete the product form as an Excel spreadsheet and e-mail it). The customer (e.g. Nortel Networks) would then validate and approve the data (see section 6.3.2.1) before manually entering the information into the appropriate designated field of the component database. The data supplied in the second SEAP pilot study was converted into HTML and added to a temporary internal web site.

The second method requires the supplier to complete each product data form using an Internet interface. This then enables the supplier to send the data through a secure firewall in the Nortel Networks network where it can be automatically held in a database.

The first method was considered too labour and resource intensive. In an attempt to make the questionnaire completion process and transfer of data as automated as possible a web version of SEAP was investigated. The alpha version of web-SEAP consists of a form for the main questionnaire and a form for the submission of product material composition data. All the information is entered into the web forms and submitted to a database in Filemaker Pro, which is running on a PC. The data is then made readily available on the web for Nortel Networks users.

The architecture of the proposed data management system is presented in Figure 16.

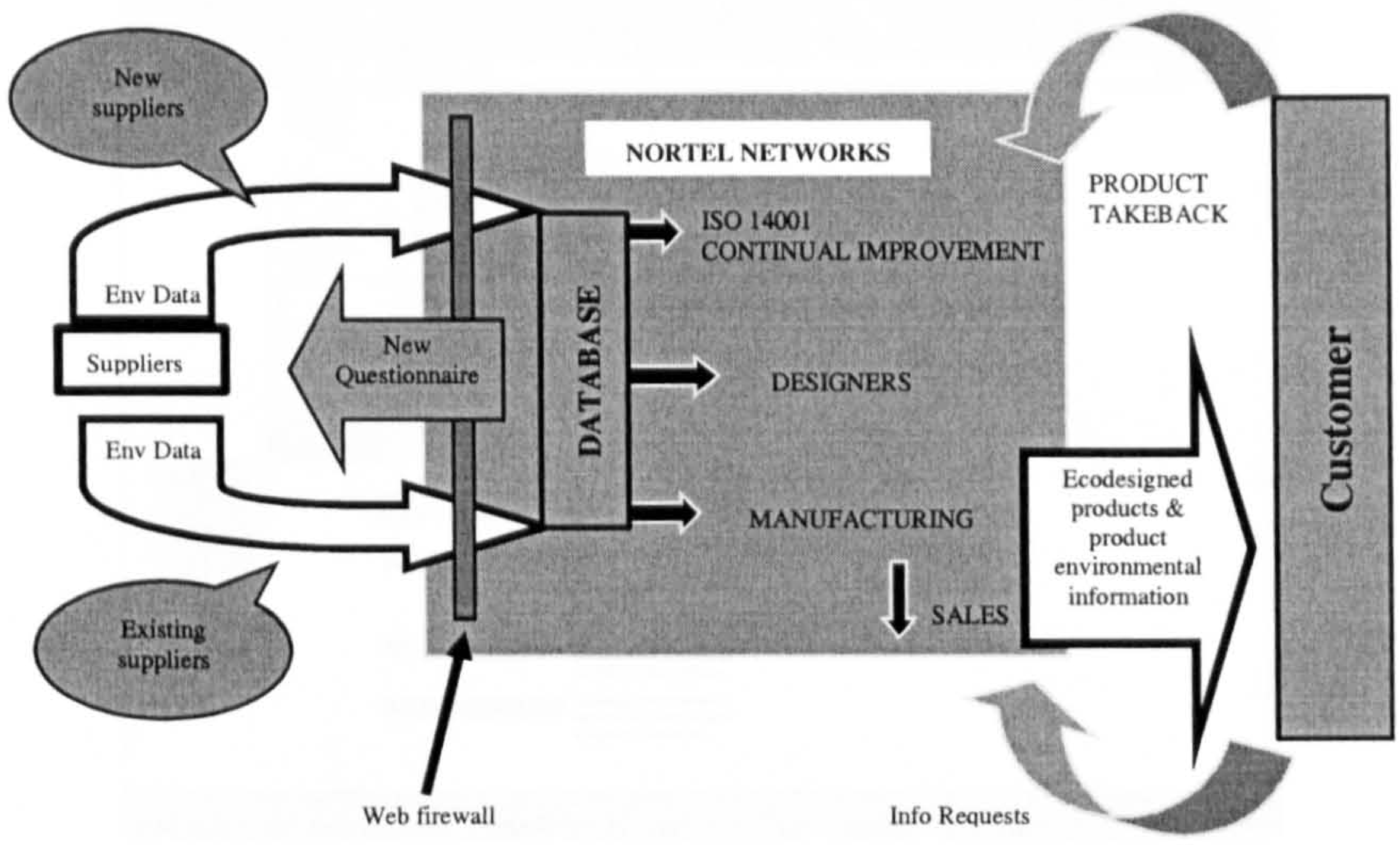


Figure 16. Product Environmental Information System

6.3.2 Web-SEAP

Web-SEAP was developed as a solution to the capture of environmental data from the supply chain. Its development incorporated all the feedback obtained from the SEAP pilot studies.

Web-SEAP is essentially a web site divided into two core areas. One area is for use by the supplier for entering data and would be password protected. The second area is for use by Nortel Networks and focuses on the storage and presentation of data. In this section screen shots are provided as figures in the text of a selection of the web pages in web-SEAP. All the web files have been printed and are provided in Appendix X.

Supplier Area

Once a supplier (new or existing) has gained security access to web-SEAP they are presented with a brief menu with links to:

- guidelines for completing the SEAP questionnaire;
- the SEAP questionnaire; and
- the product data entry form.

(see Figure 17).

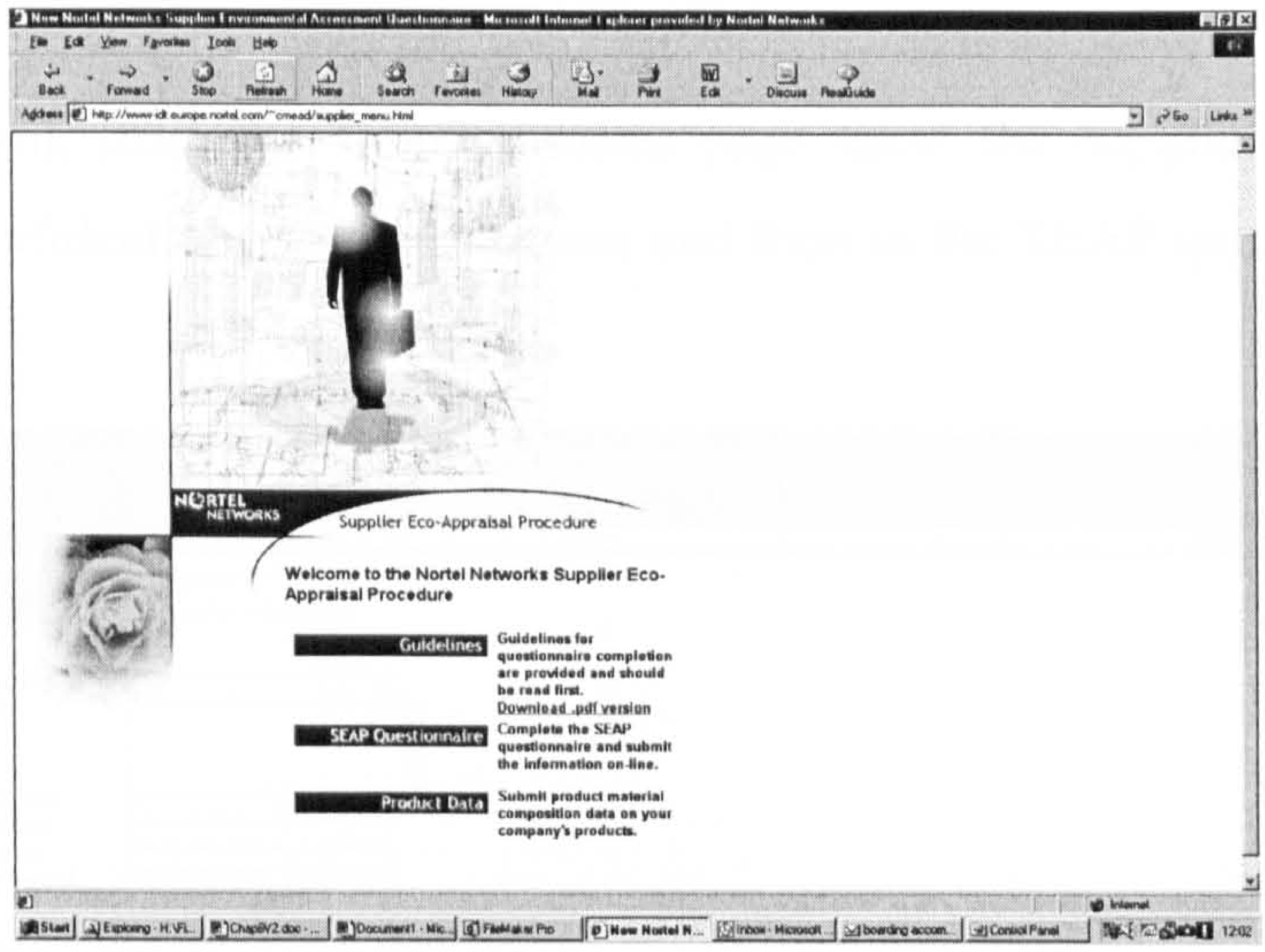


Figure 17. Web-SEAP Supplier Menu

The guidelines were developed to provide the suppliers with guidance to answering the questions in the questionnaire and to provide an indication of what exactly would be expected of the supplier if they answered the question either yes or no as appropriate. The guidelines are an integral part of web-SEAP and are considered an important means of communication between the supplier and Nortel Networks (see Figure 18). Environmental assessment questionnaires received from customers of Nortel Networks rarely include any detailed information on the objectives of the assessment and definitions and explanations of what information is actually required. This is also the case for pre-SEAP Nortel Networks supplier assessment questionnaires. This situation was considered unsatisfactory, hence the development of the guidelines.

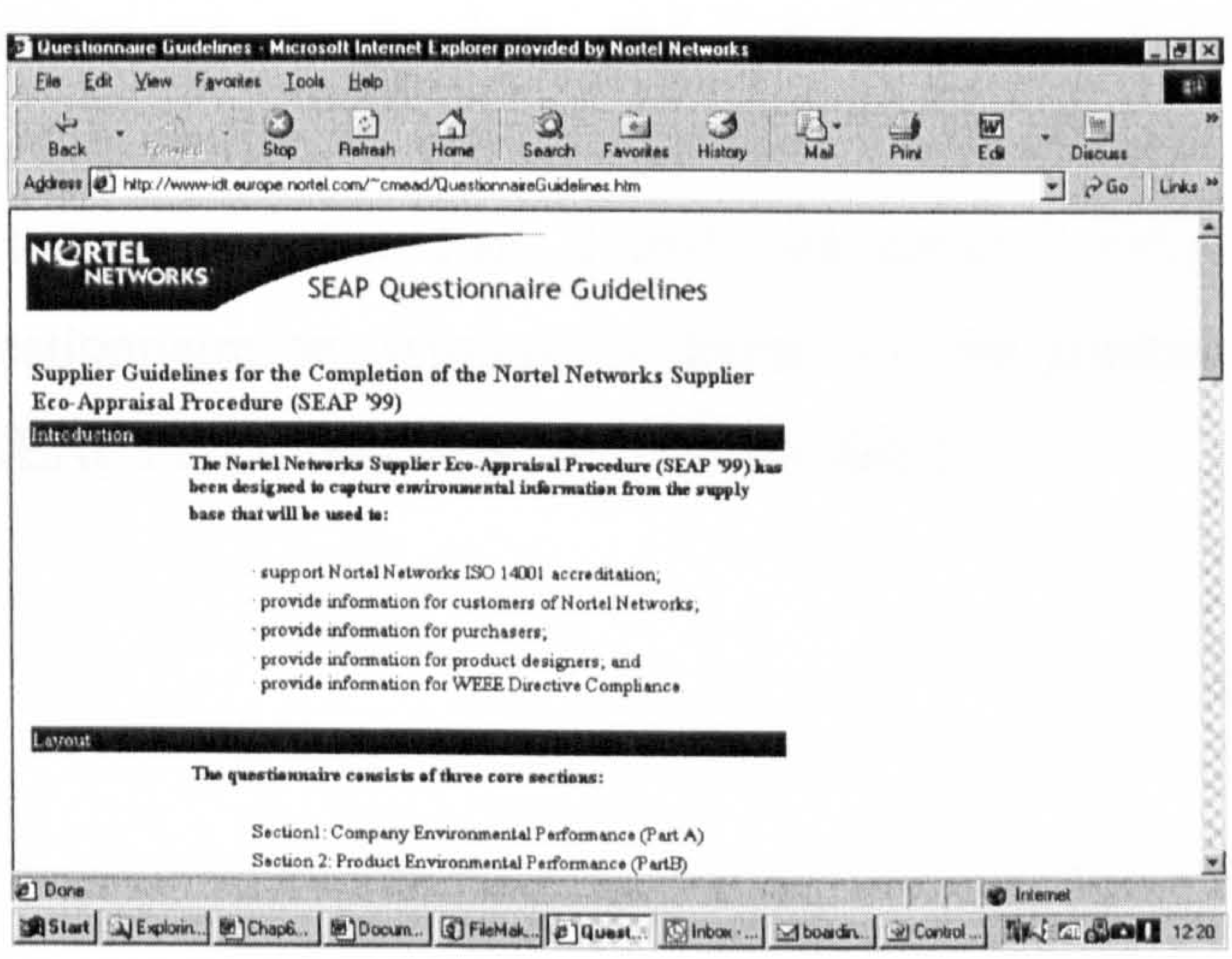


Figure 18. SEAP Supplier Guidelines

Following the link from the supplier menu page takes the supplier to a disclaimer regarding the confidentiality of information and then to the SEAP questionnaire Part A (see Figure 19).

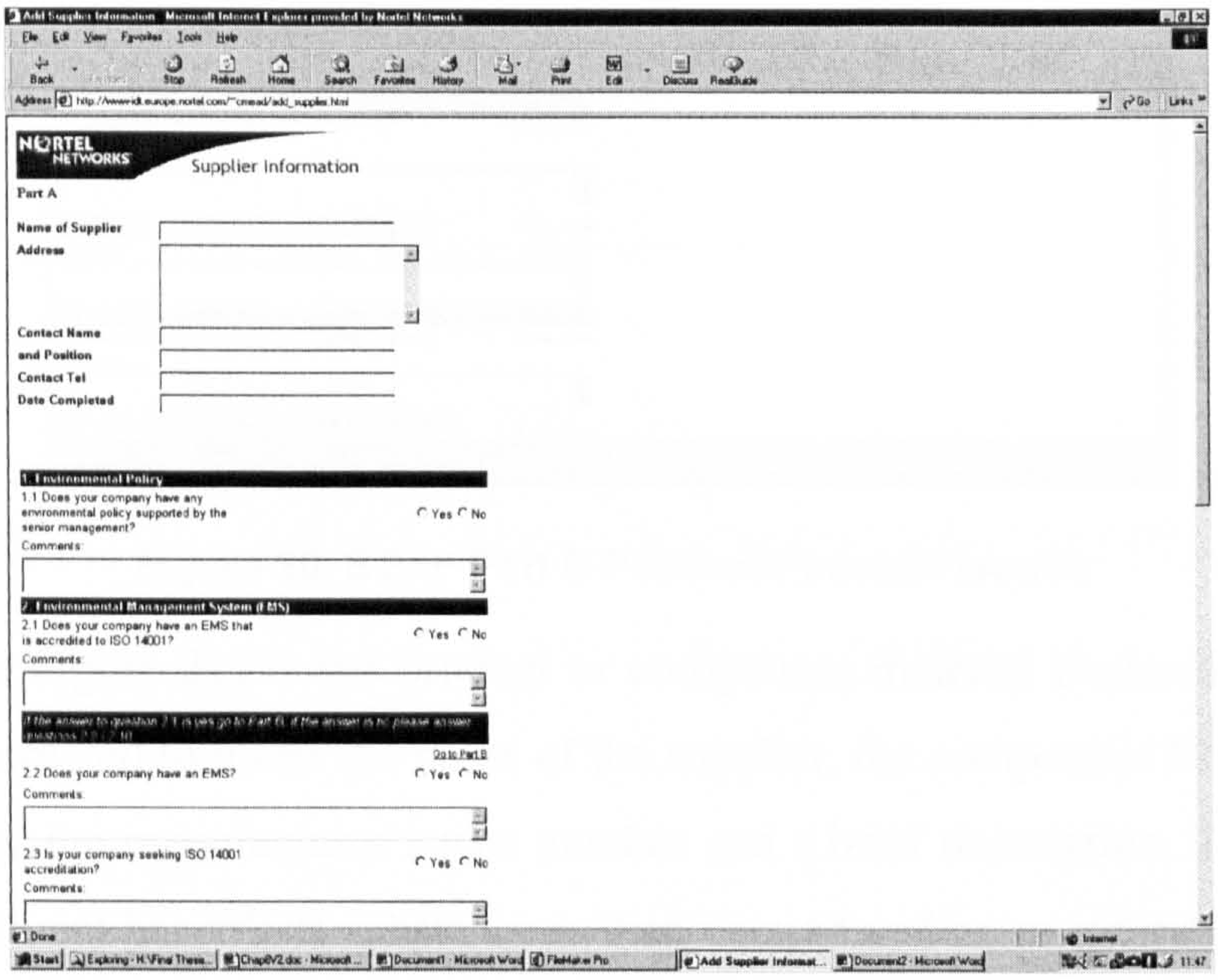


Figure 19. SEAP Questionnaire

SEAP Part A is designed to assess a supplier's commitment to the implementation of environmental management systems and to a programme to reduce risks of environmental pollution and business interruption.

The next page is SEAP Part B (see Figure 20). This set of questions focuses on product related environmental issues. The objective is to evaluate the supplier's performance in terms of a commitment to product and process environmental performance improvement and the ability to provide product environmental information. The supplier is requested to complete Part B and then either finishes the process after submitting the questionnaire or continues to Form A1, the product data form if they have specified in SEAP Part B that they can provide data).

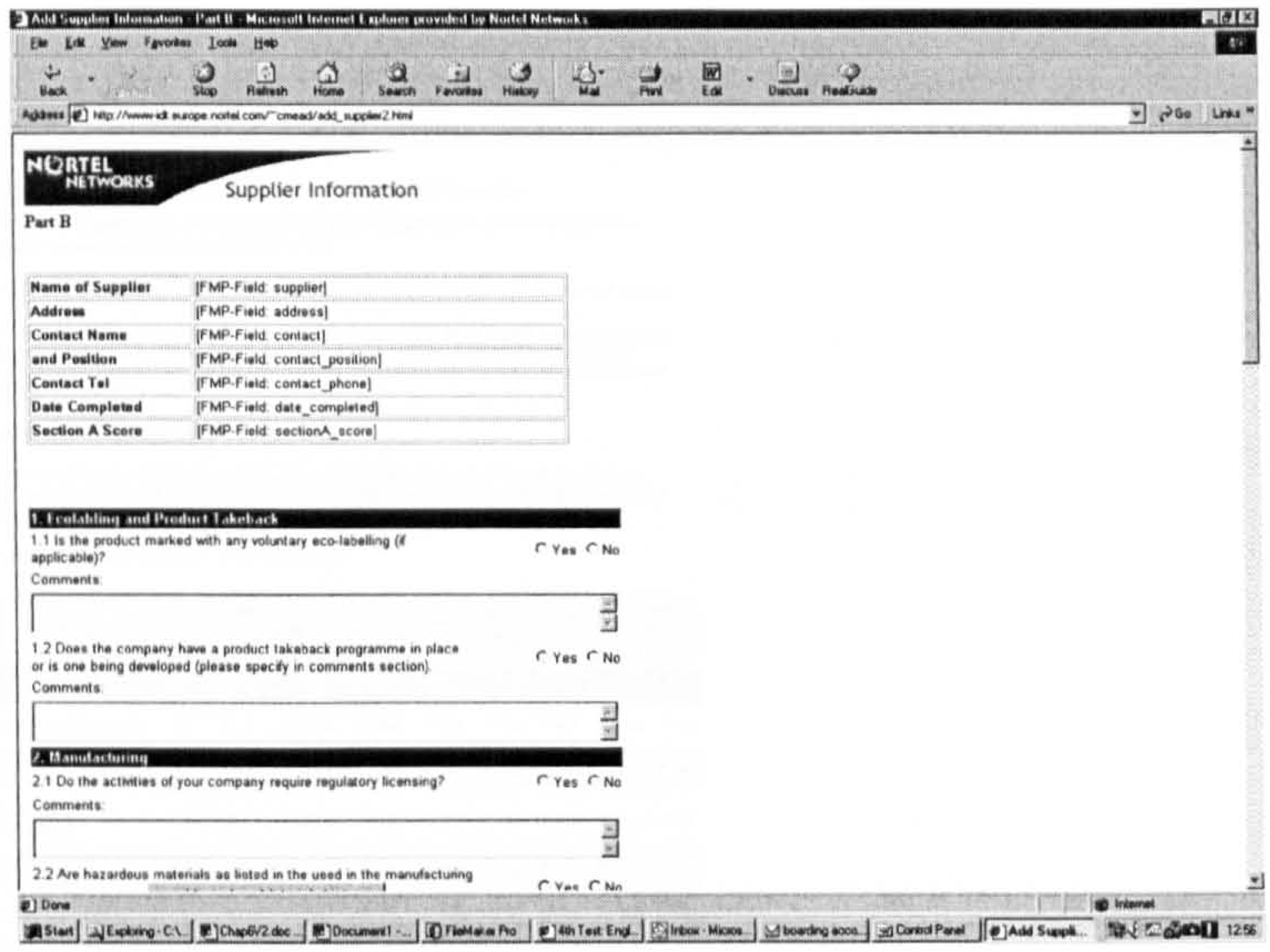


Figure 20. SEAP Part B Product Focused Issues

Form A1 (see Figure 21) is the product or component material declaration form. The supplier is instructed to insert the name of the supplier, the component Nortel Networks part number or the manufacturer's part number and a brief description. The percentage of each constituent hazardous substance is then entered and/or an indication of whether the substance is used in manufacture, planned for phase-out or emitted during use. The same information for constituent substances, in addition to the specified hazardous substances, can then be added along with a component total mass. The aim is for the supplier to declare as close to 100 percent substance composition of the component as possible.

Once a supplier is registered with-in web-SEAP it would be possible for them to add product data as required per component. If implemented within Nortel Networks it would be logical to start with declarations from newly qualified and coded components.

The submission of the on-line questionnaire results in the supplier being calculated a percentage score.

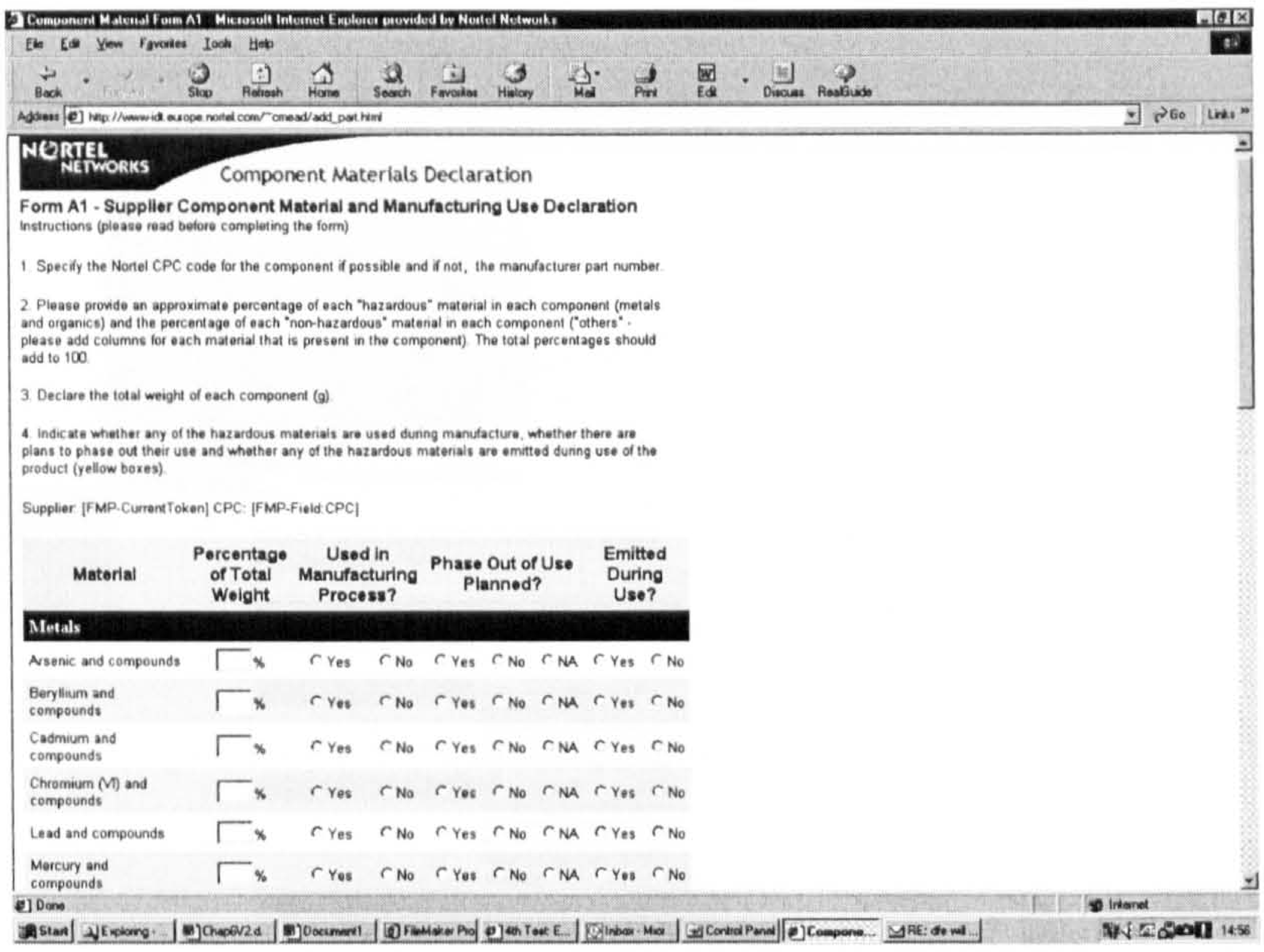


Figure 21. Product Material Declaration Form A1

Nortel Networks Area

This area of web-SEAP is designed to present the supplier environmental company and product performance data to any interested party within Nortel Networks. It will provide information for ISO 14001 continual improvement and component and supplier selection and potentially for Nortel Networks product material profiles.

The menu page can be seen in Figure 22.

The menu page contains links to enable the user to access:

- a list of component part numbers with material data and suppliers that have submitted the data (see Figure 23);
- a summary of each supplier environmental appraisal scores for Part A and Part B (see Figure 24); and
- a list of suppliers and their full questionnaire responses (see Figure 25).

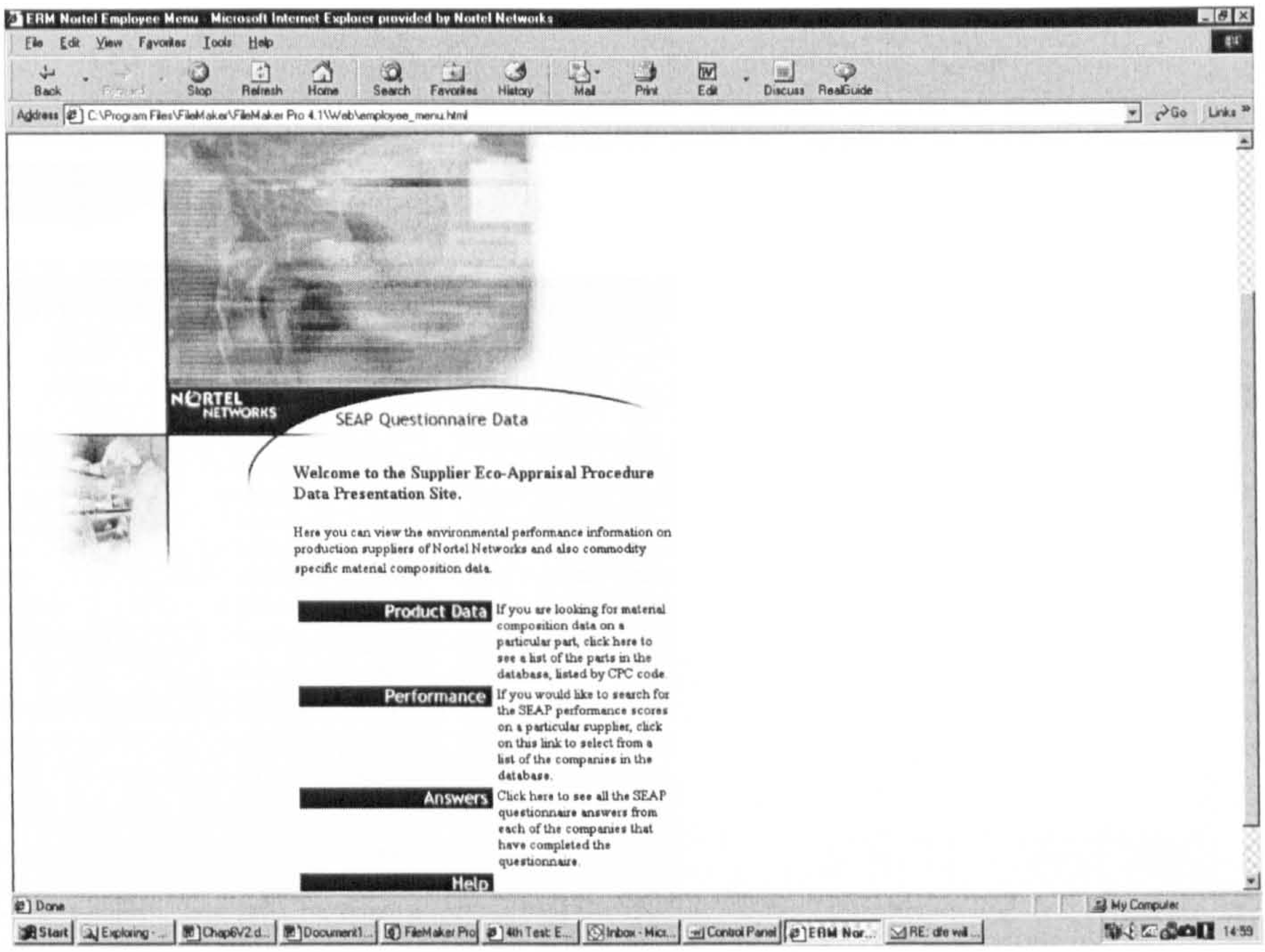


Figure 22. Nortel Networks SEAP Menu

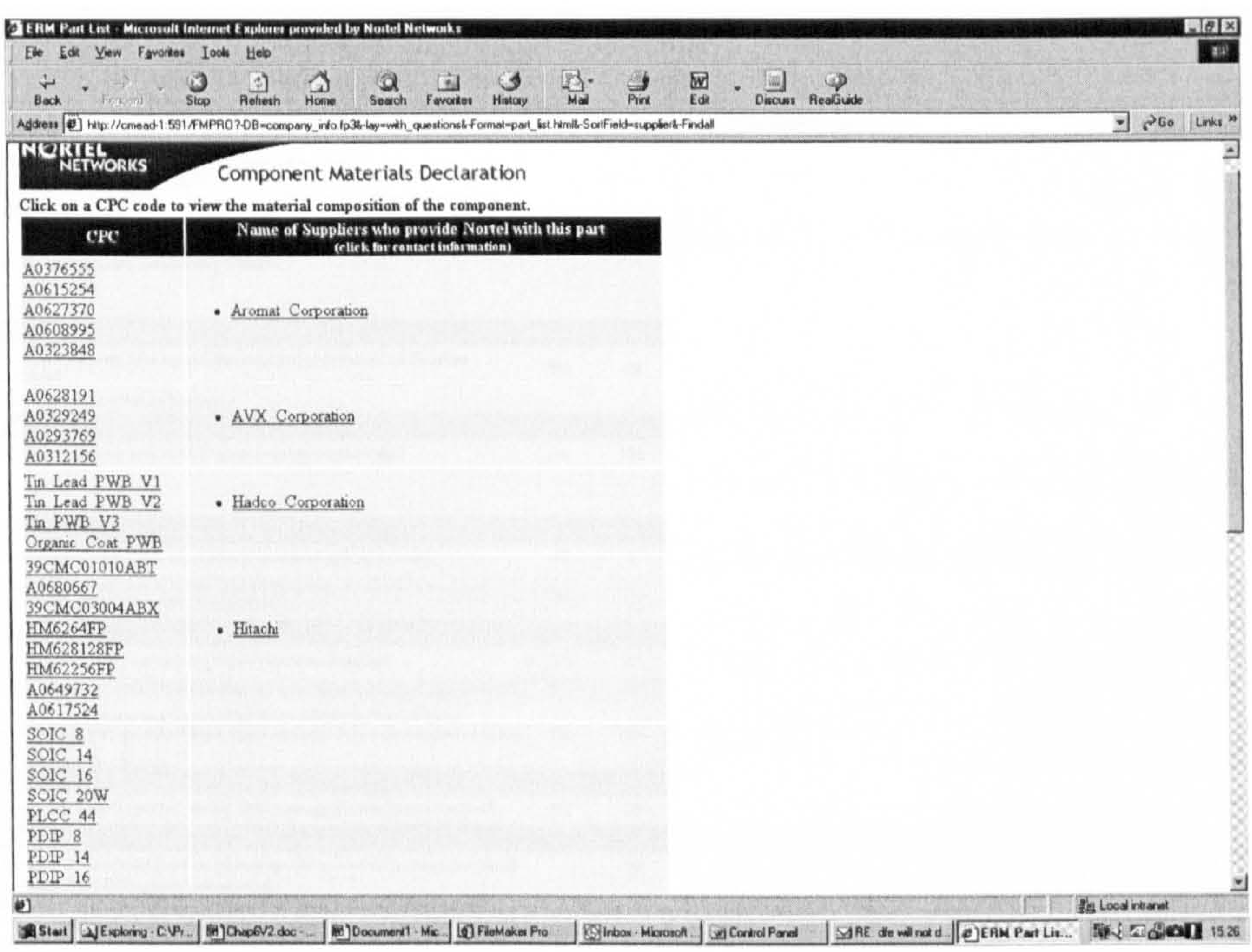
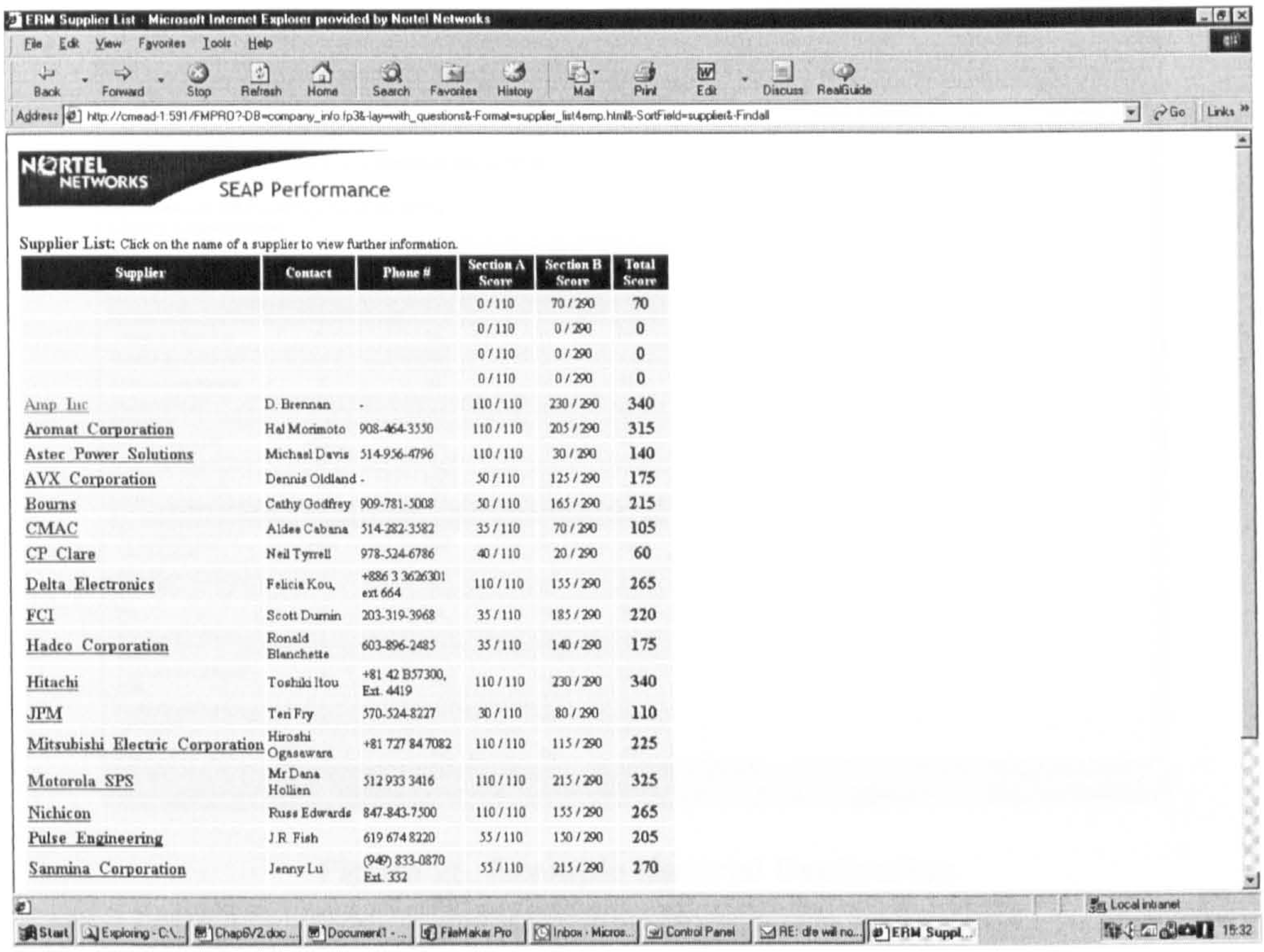


Figure 23. List of Supplier Parts with Material Data

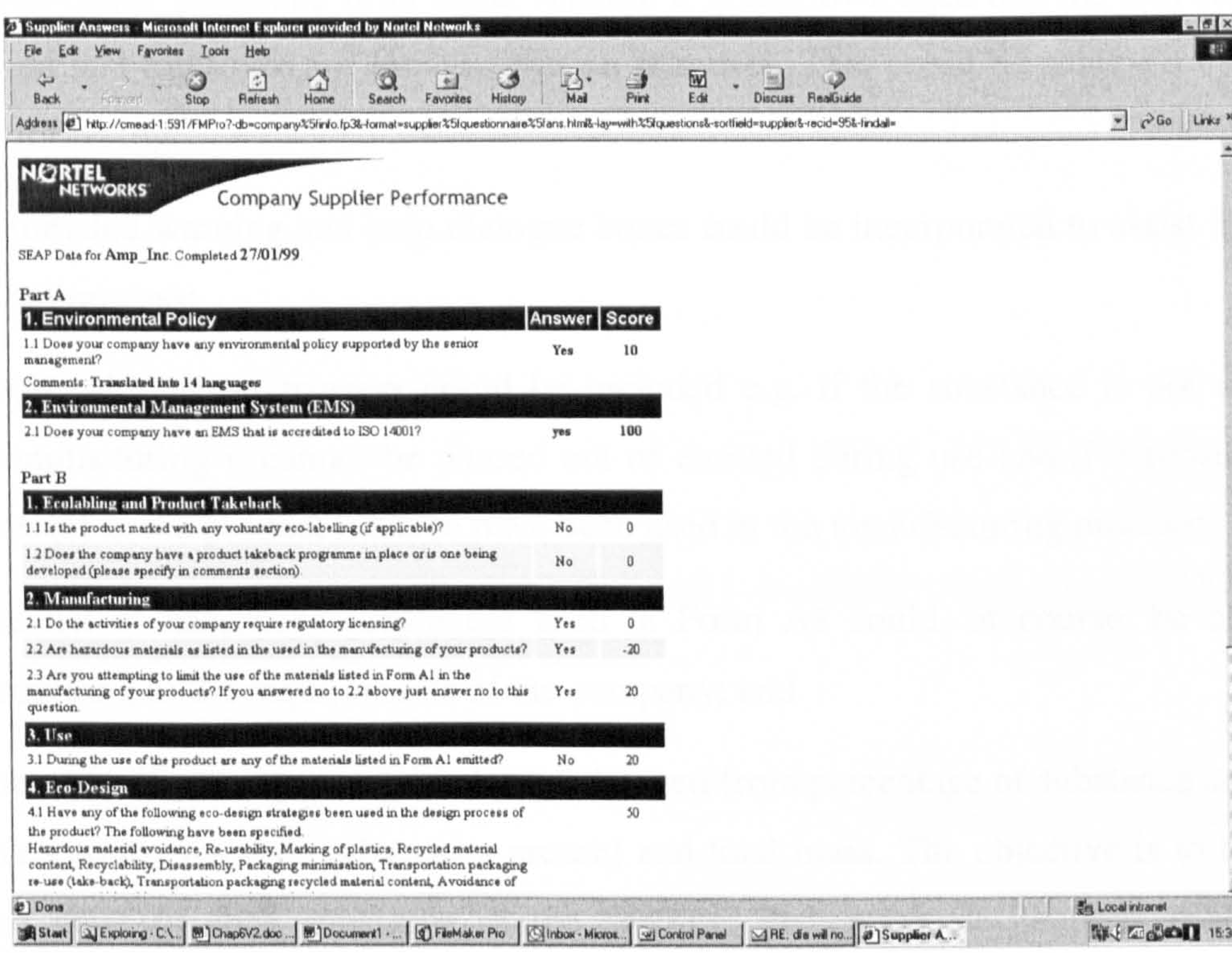


SEAP Performance

Supplier List: Click on the name of a supplier to view further information.

Supplier	Contact	Phone #	Section A Score	Section B Score	Total Score
			0 / 110	70 / 290	70
			0 / 110	0 / 290	0
			0 / 110	0 / 290	0
			0 / 110	0 / 290	0
Amp Inc	D. Brennan	-	110 / 110	230 / 290	340
Aromat Corporation	Hal Morimoto	908-464-3550	110 / 110	205 / 290	315
Astec Power Solutions	Michael Davis	514-956-4796	110 / 110	30 / 290	140
AVX Corporation	Dennis Oldland	-	50 / 110	125 / 290	175
Bourns	Cathy Godfrey	909-781-5008	50 / 110	165 / 290	215
CMAC	Aldee Cabana	514-282-3582	35 / 110	70 / 290	105
CP Clare	Neil Tyrrell	978-524-6786	40 / 110	20 / 290	60
Delta Electronics	Felicia Kou,	+886 3 3626301 ext 664	110 / 110	155 / 290	265
FCI	Scott Durnin	203-319-3968	35 / 110	185 / 290	220
Hadco Corporation	Ronald Blanchette	603-896-2485	35 / 110	140 / 290	175
Hitachi	Toshiki Itou	+81 42 B57300, Ext. 4419	110 / 110	230 / 290	340
JPM	Teri Fry	570-524-8227	30 / 110	80 / 290	110
Mitsubishi Electric Corporation	Hiroshi Ogasawara	+81 727 84 7082	110 / 110	115 / 290	225
Motorola SPS	Mr Dana Hollien	512 933 3416	110 / 110	215 / 290	325
Nichicon	Russ Edwards	847-843-7500	110 / 110	155 / 290	265
Pulse Engineering	J.R. Fish	619 674 8220	55 / 110	150 / 290	205
Sanmina Corporation	Jenny Lu	(949) 833-0870 Ext. 332	55 / 110	215 / 290	270

Figure 24. Supplier Summary SEAP Scores



Company Supplier Performance

SEAP Data for Amp_Inc. Completed 27/01/99

Part A

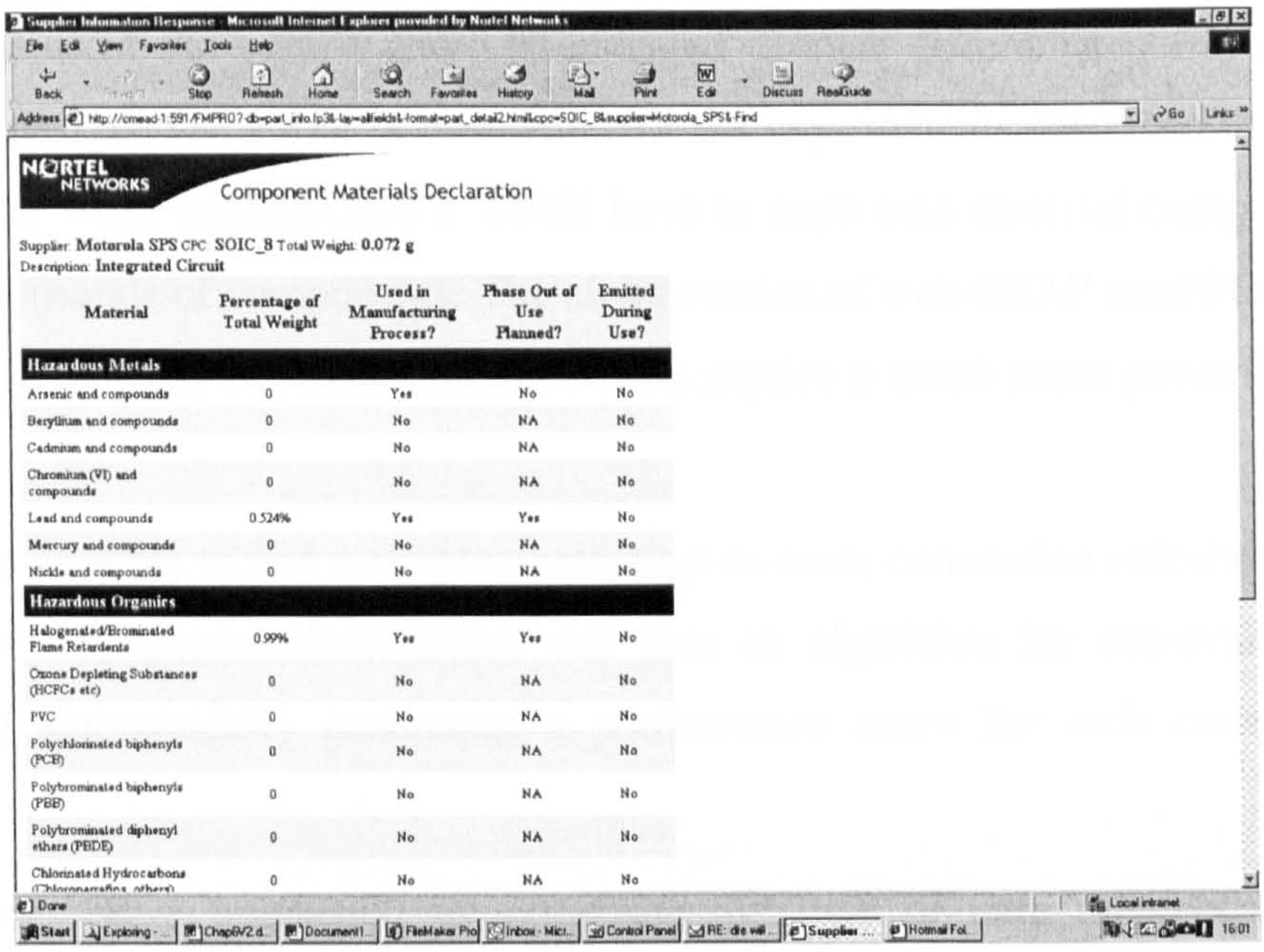
1. Environmental Policy	Answer	Score
1.1 Does your company have any environmental policy supported by the senior management?	Yes	10
Comments: Translated into 14 languages		
2. Environmental Management System (EMS)		
2.1 Does your company have an EMS that is accredited to ISO 14001?	yes	100

Part B

1. Ecolabling and Product Takeback		
1.1 Is the product marked with any voluntary eco-labelling (if applicable)?	No	0
1.2 Does the company have a product takeback programme in place or is one being developed (please specify in comments section).	No	0
2. Manufacturing		
2.1 Do the activities of your company require regulatory licensing?	Yes	0
2.2 Are hazardous materials as listed in the used in the manufacturing of your products?	Yes	-20
2.3 Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? If you answered no to 2.2 above just answer no to this question.	Yes	20
3. Use		
3.1 During the use of the product are any of the materials listed in Form A1 emitted?	No	20
4. Eco-Design		
4.1 Have any of the following eco-design strategies been used in the design process of the product? The following have been specified. Hazardous material avoidance, Re-usability, Marking of plastics, Recycled material content, Recyclability, Disassembly, Packaging minimisation, Transportation packaging re-use (take-back), Transportation packaging recycled material content, Avoidance of		50

Figure 25. Example Questionnaire Response

Each part number listed in the list of component part numbers with material data is a link to the actual material data supplied. An example of a completed materials declaration from a supplier is provided in Figure 26.



Component Materials Declaration

Supplier: Motorola SPS CPC: SOIC_8 Total Weight: 0.072 g
Description: Integrated Circuit

Material	Percentage of Total Weight	Used in Manufacturing Process?	Phase Out of Use Planned?	Emitted During Use?
Hazardous Metals				
Arsenic and compounds	0	Yes	No	No
Berylium and compounds	0	No	NA	No
Cadmium and compounds	0	No	NA	No
Chromium (VI) and compounds	0	No	NA	No
Lead and compounds	0.524%	Yes	Yes	No
Mercury and compounds	0	No	NA	No
Nickle and compounds	0	No	NA	No
Hazardous Organics				
Halogenated/Brominated Flame Retardents	0.99%	Yes	Yes	No
Ozone Depleting Substances (HCFCs etc)	0	No	NA	No
PVC	0	No	NA	No
Polychlorinated biphenyls (PCB)	0	No	NA	No
Polybrominated biphenyls (PBB)	0	No	NA	No
Polybrominated diphenyl ethers (PBDE)	0	No	NA	No
Chlorinated Hydrocarbons	0	No	NA	No

Figure 26. Example Material Declaration

6.3.2.1 Web-SEAP Discussion

The web-SEAP presented is an alpha version. It is acknowledged that the tool could be modified and improved for implementation purposes. This could be achieved by some of the following:

- automated warning and help dialogue boxes could be incorporated to assist the data input process;
- automatic answer triggers could be included e.g. if the substance is not used in manufacturing it cannot be phased out or emitted during use and if a substance is present in the product it has to have been used in the manufacturing process;
- the list of hazardous substances used in Form A1 could, of course, be changed according to the requirements of the company; and
- the units of substances could also be changed from percentage of substance and total mass to the mass of substances present and total mass. The objective is to identify the mass of each substance in the product. Percentage declarations enable the supplier to generate one declaration for a group or family of components with the same substance composition but different masses (e.g. integrated circuits with the same package types but different pin counts).

Many elements of the system could be changed to meet different requirements. Web-SEAP was designed as a tool to meet some of the requirements described in Chapter 5. If web-SEAP were implemented it would have to cope with material composition data on many thousands of components. The alpha version of web-SEAP used Filemaker Pro as a database but any launched system would require a much more powerful database structure.

It would be possible to add a simple percentage-to-mass conversion calculation into the system for the material declarations and also an algorithm for eco-evaluation (see Chapter 7) automatically generating a performance score for each component and supplier.

Investigations were conducted to determine the type of data that could be made available in the Nortel Networks component engineering database partSMart. It would be relatively straightforward to add an environmental compliance or performance field and add information on the presence of substances that are earmarked for phase-out or a statement declaring compliance. Likewise it would also be straightforward to add any eco-evaluation scores for components.

The major obstacle is transferring comprehensive material declarations on components from suppliers in HTML format to a designated field in the component database and then enabling these declarations to be collated in a bill of materials. The information could be added to the partSMart database manually and the data extracted in the generation of a bill of materials for the Nortel Networks product using software products such as WebCROP. WebCROP is already used to review product attribute data in bill of materials for products. A standard query could then be written to generate a total material content for the final product in theory.

The preferred method would involve supplier material declarations automatically being added to the component database after submission on the Internet. This scenario is plausible and would require the direct importation of the material data from one database to designated fields in the Nortel Networks component database.

Validation

A further requirement is the auditing or validation of the data on supplier eco-performance and the product material data from suppliers. This would require the periodic checking of the information provided by suppliers. A supplier auditing procedure exists within the supply management function of Nortel Networks to ensure the supplier meets the requirements of the internal standards for quality and reliability. It is suggested that additional elements are added to the auditing procedure that provide a means of verifying a supplier's performance and the product material declarations provided.

Particularly important is the method or technique the supplier uses to generate material declarations as this will have an impact on the accuracy of the declaration. Three method types are generally available:

- manufacturing mass balance;
- design specifications and bill of materials; and
- destructive chemical analysis.

In the SEAP pilot studies few suppliers were actually able to provide data. Those that could preferred to use design specifications as the predominant source of information. Mass balance calculations would require a rigorous measurement programme to be implemented and the process would be complicated with allocation issues. It was suggested by one supplier that bill of materials information needed to be used with some caution as they may state the mass or volume of material to be used per unit for manufacture but some of the material may end up as waste. Destructive chemical analysis is generally considered as a last resort because of the cost. However, in terms of an auditing or validation method for companies such as Nortel Networks it offers the only way of checking material declarations.

An MSc research project was designed by the research engineer to investigate the various analytical techniques available. The MSc student was supervised by the research engineer. The objectives of the research were to:

- "Provide accurate, comparative information on the material content of electronic components from selected suppliers of Nortel Networks;
- Assess the economic feasibility of destructive analysis to determine component material content; and
- Identify the techniques used by a selection of suppliers in the provision of component environmental data to Nortel Networks, and to investigate a method to validate supplier product eco-data" (Widdowson, 2000)

The conclusions of the research were :

"Validation of quantitative data can only accurately be carried out if the exact method of initial analysis is known and replicable. Different methods of analysis will yield different results due to the techniques used, the different sensitivities that each method may have and the interference associated with each technique" (Widdowson, 2000).

Taking into consideration the difficulties associated with the development of a quantitative method the methods recommended are:

i) Particle size reduction by grinding to ensure an homogenous powder;

ii) Scanning Electron Microscope/Energy Dispersive X-ray for initial analysis to determine the material composition and for the semi-quantitative analysis of bromine;

iii) Use of a combination of plasma techniques (Inductively Coupled Plasma /Sector Mass Spectrometry, Inductively Coupled Plasma/Atomic Emission Spectroscopy) to determine quantitatively the elemental composition.

iv) Pre-treat the sample by acid/caustic leaching to enable organic compounds to be determined by either High Performance Liquid Chromotography/Mass Spectrometry or Gas Chromotography/Mass Spectrometry.

The cost of quantitative analysis is considerable and is estimated per component as potentially £300 or greater (Widdowson, 2000).

It can be concluded that for validation purposes it would be preferential to have a standard industry-wide process for component material declaration that uses a common method. A standard validation procedure could then be developed and an appropriate strategy introduced.

6.4 Electronics Supply Chain Restructuring

In the last two years the structure of the Nortel Networks supply chain has undergone radical change. This change has taken place across the entire electronics industry (identified through numerous personal communications with representatives of many organisations). The general move has been away from in-house manufacturing of products and towards focussing on the areas of core expertise of the company (technology research and development, customer service etc..). This shift has resulted in both mechanical and electronic assemblies being manufactured by Electronic Manufacturing Service (EMS) companies or "contract manufacturers".

The shift has also resulted in an additional complexity to a solution to product material data capture as a further link in the supply chain now exists. In a contract manufacturing scenario the component suppliers may still be qualified and components purchased by systems providers i.e. Nortel Networks, so ownership of the supply chain is maintained and product material data can be exchanged between the component supplier and Nortel Networks. However, future scenarios may involve contract manufacturers being provided with a product design and specification and freedom to choose their own suppliers. One of the major financial benefits of using contract manufacturers is the opportunity to take advantage of their greater buying power and leverage of the supply chain because of the enormously high purchase volumes. In this situation companies such as Nortel Networks would require the contract manufacturer to supply a product materials declaration and it would be the responsibility of the contract manufacturer to obtain material data direct from the component manufacturer.

The materials declaration from the contract manufacturer could be made in the same format as the component declaration or it could be made in a format such as the ECMA TR70 materials declaration. The European Computer Manufacturers Association developed a template for materials declarations for electronics products between 1996 and 1998. It is known as Technical Report 70 and consists of a flexible approach to communicating product environmental performance information to the end user of the product. The customer information section is comprised of eleven sections (see Appendix IV) including upgradability, energy consumption, electro-magnetic, physical and chemical emissions, materials content, disassembly and packaging.

The materials declaration template being developed by the EICTA supply chain management group is also intended for use as a sub-assembly materials declaration tool.

6.5 Data Capture Conclusions

Programme 2 of the research project was designed to identify how product environmental performance data could be captured from the supply chain. The research has resulted in a process for assessing the environmental performance of electronics components suppliers and a template for providing product materials data.

The preferred means of data transfer is online via the Internet. A web-based tool for supplier environmental assessment and product data capture has been developed for Nortel Networks. It is feasible for the system for data collection to be integrated with current Nortel Networks component databases although further modification of existing systems would be required.

Methods for product material data validation have been investigated but further work is required in this area.

Perhaps the most manageable and cost-effective solution for product material data capture from the supply chain is an industry collaborative approach. Three such approaches are currently undergoing development and the research detailed in this thesis has contributed to the EICTA supply chain management materials declaration template.

Chapter 7 - Data Utilisation

The objectives of this chapter are to examine how supplier component material data and company environmental performance data can be used:

- in terms of supplier selection and component selection decision-making;
- in the generation of product material profiles for complex telecommunication products, and
- in meeting the requirements of legislation and ISO 14001.

7.1 Eco-evaluation of Electronic Components

A methodology for the eco-evaluation of electronics components and mechanical assemblies has been developed. The methodology consists of a hierarchical decision-making process that reflects the availability of material content data on components and mechanical assemblies. The methodology can be used to "qualify" components and suppliers in terms of their environmental or "eco" performance and ultimately should be integrated into existing component and supplier selection decision-making processes as an integral part of improving product environmental performance.

7.1.1 Component and Supplier Selection and Qualification

Decisions on the sourcing of electronic components and mechanical assemblies (commodities) are potentially made at three stages of the product life cycle (after the bill of materials/parts list has been approved in the design):

- Component/commodity qualification
- Approved Vendor List categorisation
- Commercial manufacturing component sourcing

Details of the qualification processes in place at Nortel Networks were provided in Chapter 2. Similar qualification processes will be in use throughout the telecommunications and the electronics industry.

Any methodology proposed for the eco-evaluation of suppliers and components would have to be integrated into the existing qualification process.

7.1.2 Component Eco-Evaluation Methodology

A methodology for the eco-evaluation of components from suppliers has been developed that is based upon the available product-focused information from the supply chain (it has been shown in Chapter 6 that data availability and preferred types of product material declaration vary enormously between suppliers of electronic components). The objective is to evaluate the eco-performance of components from different suppliers as an integral element of the supplier and component qualification process. The method allows for the meeting of minimum requirements for qualification approval (regulatory compliance) and also for making more complex evaluations that incorporate the use of key environmental assessment factors and more information. The hierarchy of evaluation consists of four levels and the structure is shown in Figure 27. It is suggested that one or more levels are implemented depending on the perceived requirements of the company.

The method draws upon methods used in elements of Life Cycle Assessment but also introduces unique combinations of assessment processes.

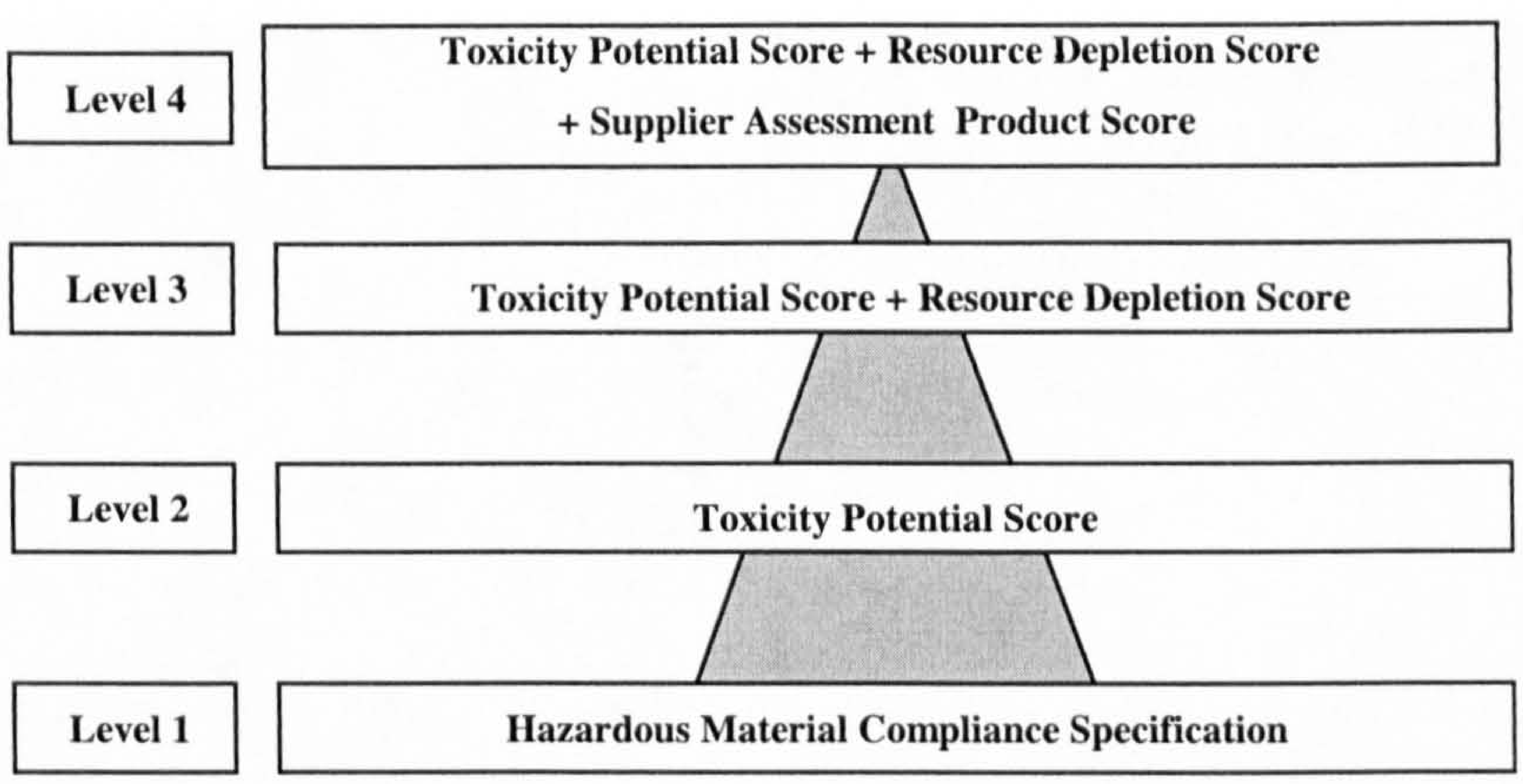


Figure 27. Component Eco-Evaluation Hierarchy

7.1.2.1 Level 1 Eco-evaluations

Level 1 eco-evaluations consist of the setting of prescriptive minimum requirements regarding the absence of specified hazardous materials in components. This has become a common approach in the electronics industry with companies setting material constraints for suppliers that revolve around one or two specified lists of banned and restricted substances. The "banned and restricted" substances may actually be banned or restricted under regional or international law or may be targeted for banning or restriction. Some of the restricted substances on company lists will be considered harmful to the environment due to available documented evidence and are open for negotiation between customer and supplier. The focus of a level 1 eco-evaluation is essentially hazardous material compliance and a "negative" declaration (i.e. what is not in the product). Nortel Networks are about to implement a supplier product hazardous material declaration as part of supplier eco-assessments in a Core Environmental Requirements programme. This aspect of the CER programme was adapted from recommendations from the EngD research. It ensures compliance with current hazardous material regulations and anticipatory compliance with the material substitution requirements of the EU Directive on the Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (European Commission, 2000).

The prescriptive lists intended for use within Nortel Networks are presented in Tables 11, 12 and 13.

Table 11. Substances Banned from Nortel Products.

Group of substances	Substances
Chlorofluorocarbons (CFCs)	CFC-11, -12, -13, -111, -112, -113, -114, -115, -211, -212, -213, -214, -215, -216 and –217
Chlorinated hydrocarbons	1,1,1–trichloroethane, carbon tetrachloride
Bromofluorochlorocarbons (Halons)	Halon 1211, 1301 and 2402
Polychlorinated Biphenyls (PCBs)	$C_{12}H_{10-n}Cl_n$ where n>2
Polybrominated Biphenyls (PBBs)	$C_{12}H_{10-n}Br_n$ where n>2
Polychlorinated Terphenyls (PCTs)	$C_{18}H_{14-n}Cl_n$ where n>2
Bis(Chloromethyl) ether	$C_2H_4Cl_2O$
Chloromethyl methyl ether	C_2H_5ClO
(4-chlorophenyl)cyclopropylmethanone, O-[(4-nitrophenyl)methyl]oxime	$C_{17}H_{15}ClN_2O_3$
Dodecachloropentacyclo [5.3.0.0^{2,6}.0^{3,9}.0^{4,8}] decane	

Table 12. Substances Restricted in Nortel Networks Products Due to Impending Ban.

Lead
Cadmium
Mercury
HCFC
Hexavalent chromium
Halogenated flame retardants

Asbestos

Table 13.
Substances Restricted by Nortel Networks and Targeted for Elimination or Substitution Due to Their Potential to be Harmful to the Environment.

Acrolein
Acrylonitrile
Antimony and compounds
Arsenic
Benzene
Beryllium
Cyanides
Formaldehyde
Nitrogen dioxide
Selenium and compounds
Thallium and compounds
Xylenes

An obvious problem with each company (both equipment suppliers and equipment users) generating distinct lists of banned and restricted materials is the resulting need for companies to ensure compliance with widely differing customer requirements. A far better approach would be for industry groups to agree on a common process and adherence to the same lists of substances. An attempt to achieve such a united approach is currently in progress between the members of EICTA (European Information and Communication Technology Industry Association) and other trade associations. The EICTA supply chain management working group has generated a list of reportable substances and a common format for reporting and a pilot study has commenced (see Chapter 6). A similar programme is also being developed by the Electronics Industries Alliance in North America (EIA, 2000). It is likely the two will merge into one global programme. The principle of collaborative programmes is to be applauded. However, obtaining a consensus on the approach can be problematic.

Prescriptive negative material declarations can meet the requirements of component qualification activities because it is relatively simple to set a benchmark or minimum compliance score, particularly for regulated materials. If the specified "banned" materials are present the component does not comply, if they're not, the component does comply. Negotiations on "restricted" substances may take place between customer and supplier and agreements may be made or exemptions granted accordingly that will be influenced by the technical feasibility or functional detriment caused by substitution or elimination.

A level 1 eco-evaluation integrates well with the current component qualification process as an appropriate flag or information can be captured in the existing regulatory compliance field of the component database. This is a simple action for those substances that are subject to legal ban or where a ban is imminent (RoHS Directive) as it simply involves the supplier of the component declaring that the substances are not present. It was shown in chapter six that this is the preferred type of material declaration for suppliers mainly because it is the simplest and involves the least cost. Companies such as Nortel Networks are then fully aware of the material regulatory compliance status of the components in their equipment and it would just require a declaration from the contract manufacturer of the sub-assemblies that the solder was compliant and the Nortel Networks product would be known to be compliant. This information can then be conveyed to the customer and appropriate regulatory bodies.

However, customers of Nortel Networks also have their own specific environmental information requirements and often request declarations of materials that are not in the product as part of the request for quotation process (see Chapter 5). Frequently information requests refer to compliance to specific, often "local", regulations and/or that certain substances in addition to those that are regulated are not present e.g. beryllium. Accurate answering of these requests for information on Nortel Networks products cannot be achieved using negative material declarations for components based on international regulations (see chapters 5 and 6). One way of generating accurate material composition information is to request detailed information from the supply chain and collate it. This means asking for more than just a regulatory compliance declaration. Details of methods to capture these data are provided in chapter 6 and the issues surrounding collation and complex product material profile generation are presented in section 7.2 of this chapter.

The capturing of component material composition information beyond compliance data also allows for more detailed and comprehensive eco-evaluation of components and products. Evaluation levels 2, 3 and 4 seek to use material and environmental performance information to contribute to product life cycle management decision-making and potential supplier differentiation.

7.1.2.2 Level 2 Eco-evaluations

Level 2 eco-evaluations focus on the intrinsic hazardous nature of the materials within a component. It extends beyond simple hazardous material regulatory compliance and consists of the generation of a Toxicity Potential Score. This is attained by dividing the mass of selected substances in the electronic component, which are considered to be key toxicity indicators, with the respective comparative toxicity factor for human and ecological toxicity. The result is then multiplied by one hundred to generate a percentage (the percentage being the substance percentage of the toxicity factor). The individual substance human and ecological toxicity scores are then summed to produce a total Toxicity Potential Score for the component:

$$TPS_{comp} = \sum TPS_{sub}$$

and

$$TPS_{sub} = \left(\left(\frac{M_{sub}}{HTF_{sub}}\right)\times 100\right) + \left(\left(\frac{M_{sub}}{EF_{sub}}\right)\times 100\right)$$

Where TPS_{comp} = Toxicity Potential Score of component (%)

TPS_{sub} = Toxicity Potential Score of substance (%)

M_{sub} = Mass of substance (kg)

HTF_{sub} = Human Toxicity Factor of substance (OHLV (kg per kg body weight per day))

EF_{sub} = Ecotoxicity Factor of substance (PNEC (kg per m^3))

The higher the TPS_{comp} the poorer the hazardous material performance for the component (from a respective supplier). The indicator substances are pre-selected and agreed before the qualification of each component from different suppliers. A suggested list of hazardous material indicator substances, their Oral Human Limit Values and aquatic PNEC values is provided in Table 14. This list is adapted from the original listing developed for the supplier appraisal and data capture pilot study that was conducted as part of the research (detailed in chapter 6). The substances were selected on the basis of their known inherent toxicity, relevance to the electronics industry and, regulatory and customer significance. Indicator substance selection is, of course, a subjective and flexible process. Companies will choose substances that they feel are appropriate and which satisfy their requirements. Nortel Networks may wish to add some of those substances present on their "restricted" list.

This method requires a quantitative declaration from the supplier of toxicity indicator substances present in the component.

The Toxicity Potential Score attempts to evaluate the component according to the material constituents in terms of potential hazard to humans and the environment. Thus, two factors are used; one to represent potential human toxicity and one to represent potential ecotoxicity.

Table 14. Toxicity Potential Score Indicator Substances

Substance	Oral Human Limit Value (kg per kg body weight per day)	Aquatic Predicted No Effect Concentration (kg per cubic metre)
Antimony	8.60E-10	4.60E-04
Arsenic	2.14E-09	2.40E-05
Beryllium	5.00E-10	1.60E-07
Cadmium	1.00E-09	3.40E-07
Chromium III	5.00E-09	3.40E-05
Chromium VI	3.00E-09	8.50E-06
Cobalt	1.40E-09	2.60E-06
Copper	1.40E-07	1.10E-06
Lead	3.60E-09	1.10E-05
Mercury	7.20E-10	1.30E-07
Molybdenum	1.00E-08	2.90E-05
Nickel	5.00E-09	1.80E-06
Polybrominated Biphenyls	No data	No data
Polybrominatd Diphenyl-Ethers	No data	No data
Polychlorinated Biphenyls	No data	No data
Selenium	5.00E-09	5.30E-06
Silver	No data	No data
Tin	2.00E-06	1.80E-05
Vinyl chloride	3.51E-11	8.20E-03
Zinc	9.90E-10	6.60E-06

7.1.2.2.1 Human Toxicity

A number of human toxicity factors exist (e.g. Oral Human Limit Value, Inhalatory Human Limit Value, Maximum Allowable Concentration) any of those available could be used for the eco-evaluation as long as consistency in their application is maintained. Factors influencing the factor selection process include availability, quality, breadth and applicability of data. In the example evaluations presented in this chapter Oral Human Limit Value (OHLV) has been used. The values have been taken from Huijbregts, 1999 who obtained OHLVs from a variety of published sources (FAO/WHO, 1993, 1998, 1999; JECFA, 1982, 1986, 1989, various RIVM documents (Annema et al., 1996, Janus et al., 1994, Vermeire et al., 1991, Vermeire, 1993, Jansen et al, 1998), the IRIS online internet database (USEPA, 1998), the online internet database of the Environmental Defense Fund (1999), and Guinee et al., 1996 and others) to generate toxicity potentials for 181 substances for use in LCA. OHLVs are also known as Acceptable Daily Intake (WHO) and Tolerable Daily Intake (RIVM). ADIs have been used throughout the development of risk assessment and life cycle assessment methodologies. The OHLV is the "quantity of a substance which a person can ingest orally for life on a daily basis without a significant risk of harmful effects on health. It is considered the maximum daily intake" (Heijungs, 1992).

OHLVs are determined by extrapolation of data from animal studies. These data (e.g. No Observable Effect Concentrations or Levels or LC_{50}s) are then divided by one or more uncertainty and safety factors. Typical uncertainty factors are (Vermeire et al., 1991):

- A factor of 10 for the uncertainty due to extrapolation from laboratory animals to man (the interspecies factor);
- A factor of 10 for the uncertainty due to differences in sensitivity among the population (the intra-species factor).

This results in OHLVs that incorporate potentially different safety margins for various substances and subsequently the OHVL provides a somewhat manipulated and corrupted representation of the actual toxicity ratios of the substances concerned. However, the direct use of LOECs or LC_{50}s would not be representative of human toxicity because the experimental data are results from rats, rabbits and monkeys. At least the application of uncertainty factors indirectly takes into consideration the fact that the human body will react to, and process, substances in a different manner. OHLVs can be considered to be a worst-case approach. This can be argued to be preferable if, through the application of safety factors, the major part of the human population is protected and that certain substances are effectively "punished" because of a scarcity of appropriate data (a precautionary approach).

In LCA, human toxicity potentials have been developed that also take into account human exposure to the substance incorporating fate and transport modelling (see Huijbregts, 1999 and Guinee et al, 1996). This includes consideration of Predicted Daily Intakes of each substance through each exposure route in a modelled environment and comparison of the resulting Risk Characterisation Ratio (RCR) to the RCR of a reference substance to generate a Toxicity Potential for each receiving medium (1,4-Di-Chloro-Benzene equivalents in this case of Huijbregts). The Toxicity Potentials are then multiplied with the known released mass of the substance (taken from the life cycle inventory).

Because the ultimate fate of substances contained within an electronic component is unknown (they may go to landfill, incineration, re-use or be recycled) inclusion of fate and transport factors and specification of receiving media within the eco-evaluation methodology is considered inappropriate. The main objective of the toxicity evaluation is to combine the mass of the substances present with an indicator of the intrinsic hazard potential of that substance. OHLV is considered a suitable indicator and expressing the substance mass as a percentage of the respective OHLV and aggregating for the component provides a Hazardous Material Score.

Alternatively workplace health and safety toxicity factors could be used. Middendorf et al. (2000) have used workplace Maximum Allowable Concentrations to derive Toxic Potential Indicators for use in an electronics product evaluation tool. One of the reasons for using MACs is that the values can be found on material safety data sheets typically in the form of time weighted averages (average concentration to which a worker is exposed throughout a "normal" work shift, typically eight hours) or short-term exposure limits (concentration measured over five-fifteen minutes).

Table 15 presents the comparative hazardous material content declarations for components with identical functionality from three suppliers and the resulting Human Toxicity and Ecotoxicity Potential Scores for each. The total Toxicity Potential Scores for each component are provided in Table 16. The significance of these scores is discussed in section 7.1.2.3.

The component type is a semi conductor Plastic Leaded Chip Carrier (PLCC) that is a typical integrated circuit package commonly used in the electronics industry (see Figure 28). PLCC 44 refers to the type of packaging the component has and the number of leads. It is important to note that not all PLCC 44s have the same functionality. Different devices, with possibly heavier lead-frames or smaller dies can be placed in the same package (i.e.PLCC 44). Therefore comparative material evaluations can only be made between packages with the same circuit functionality.

An integrated circuit consists of a die of a semi-conducting material, usually silicon, which is encapsulated in a package that can be plastic or ceramic. Metallic leads extend through the package to provide electrical connections to the die (TemaNord, 1995). The majority of packages on the market are now plastic.

Table 15. Component Human Toxicity and Ecotoxicity Scores

Component type – PLCC 44	Supplier 1	Supplier 2	Supplier 3	Supplier 1	Supplier 2	Supplier 3	Supplier 1	Supplier 2	Supplier 3
Material	Mass (kg)	Mass (kg)	Mass (kg)	Human Toxicity Score = (Mass of substance (kg)/OHLV of substance(kg.kg(bw)-1.d-1))*100	Human Toxicity Score = (Mass of substance (kg)/OHLV of substance(kg.kg(bw)-1.d-1))*100	Human Toxicity Score = (Mass of substance (kg)/OHLV of substance(kg.kg(bw)-1.d-1))*100	Aquatic Toxicity Score (Mass of substance(kg)/PNEC (kg.m-3))*100	Aquatic Toxicity Score (Mass of substance(kg)/PNEC (kg.m-3))*100	Aquatic Toxicity Score (Mass of substance(kg)/PNEC (kg.m-3))*100
Antimony Compounds	0.00005010880	0.00003036000	0.00002597400	5826604.65100	3530232.55800	3020232.55800	10.8932173900	6.60000000000	5.64652173900
Arsenic and compounds	0.00000000000	0.00000000000	0.00000023400	0.00000000000	0.00000000000	10934.5794400	0.00000000000	0.00000000000	0.97500000000
Beryllium and compounds	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Cadmium and compounds	0.00000000000	0.00000000000	0.00000023400	0.00000000000	0.00000000000	23400.0000000	0.00000000000	0.00000000000	68.8235294100
Chromium (III) compounds	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Chromium (VI) compounds	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Cobalt	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Copper	0.00046887500	0.00072059000	0.00057330000	334910.857100	514707.142900	409500.000000	42625.0181800	65508.1818200	52118.1818200
Lead and compounds	0.00000619649	0.00000184000	0.00000046800	172124.722200	51111.1111100	13000.0000000	56.3317272700	16.7272727300	4.25454545500
Mercury and compounds	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Molybdenum	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Nickel and compounds	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Polybrominated biphenyls (PBB)	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Polybrominated di-phenyl-ethers (PBDE)	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Poly-chlorinated biphenyls (PCB)	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
PVC	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Silver	0.00001051390	0.00000483000	0.00000163800	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Tin	0.00002572550	0.00001012000	0.00000187200	1286.27500000	506.000000000	93.6000000000	142.919444400	56.2222222222	10.4000000000
Zinc	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000	0.00000000000
Total component weight	0.00223700000	0.00230000000	0.00234000000						
Human Toxicity Score (%)				6334926.50600	4096556.81200	3477160.73800			
Ecotoxicity Score (%)							42835.1625700	65587.7313100	52208.2814100

Table 16. Total Component Toxicity Potential Scores

	Supplier 1	Supplier 2	Supplier 3
Component Toxicity Potential Score (%)	6377761.668	4162144.543	3529369

The plastic encapsulant generally consists of the following (TemaNord, 1995) although composition does vary between manufacturers (the principle behind potential supplier differentiation being explored in this thesis):

- Inert filler (usually silica glass);
- Epoxy resin
- Flame retardant (typically tetrabromobisphenol-A and antimony oxide incorporated through reaction into the chemical structure of the epoxy).
- Curing agent (amine hardener);
- Accelerator (e.g. boron trifluoride)
- Colourant (carbon black)
- Release agent (e.g. synthetic ester wax)

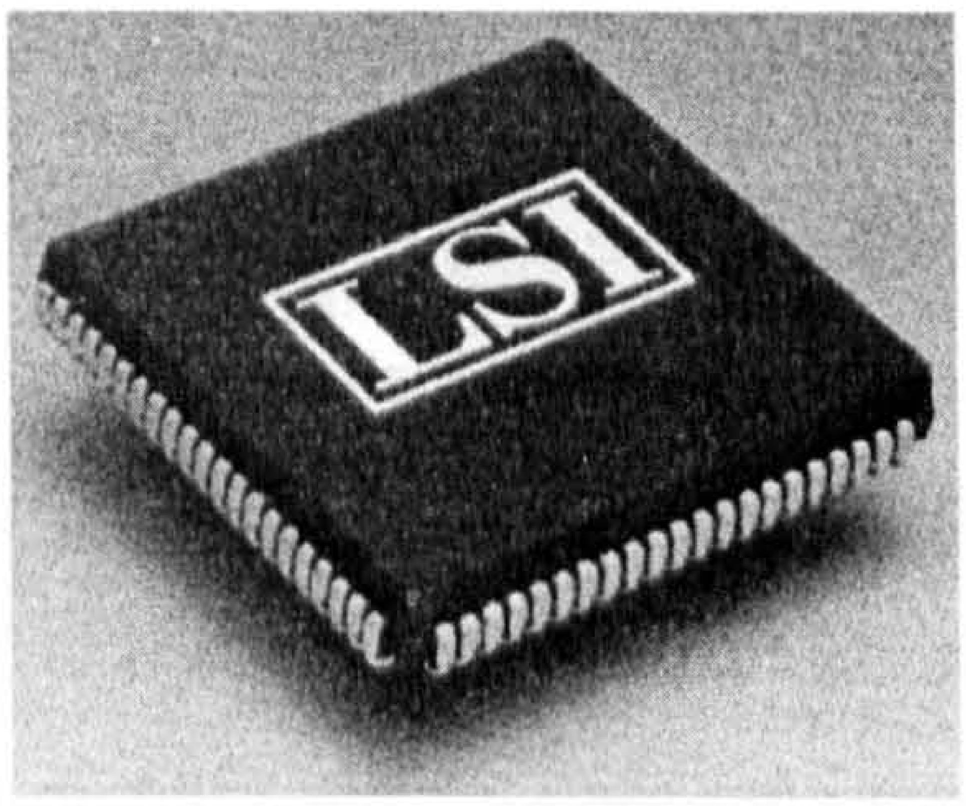


Figure 28. Example PLCC 44

The silicon chip, or die, is doped with either boron, phosphor, arsenic or antimony to improve electrical conductance.

The lead frame consists of copper or a nickel-iron alloy, coated with silver or silver-palladium where the gold wires are attached.

The gold wires connecting the chip to the lead-frame may be alloyed with copper or silicon.

7.1.2.2.2 Ecotoxicity

The ecotoxicity factor used in the component ecoevaluation methodology is the aquatic Predicted No Effect Concentration (PNEC). Aquatic PNECs for each toxicity indicator substance are provided in Table 14. The values are taken from Huijbregts, (1999) who sourced them from an internal research report (Huijbregts, 1999b) and Riza, (1999). The aquatic PNEC is considered to be an appropriate indicator of comparative potential harm to ecosystems although it does suffer from certain limitations that are discussed in section 7.1.2.2.3. It is the approved method of deriving a protection level in environmental risk assessment (EC, 1996) along with terrestrial and sedimentary PNECs. Experimental ecotoxicological data on the effects of chemicals on aquatic systems are also far more abundant than that for terrestrial and sedimentary systems.

Aquatic PNECS are generated from the results of mono-species laboratory tests or possibly, in some cases, from model ecosystem tests. Available ecotoxicity data are used to derive a No Observed Effect Concentration. The test species used are selected to represent the sensitivities of different taxonomic groups. Representatives of fish species, daphnia and algae are classically used. The principle behind this procedure is that "an assumption is made that ecosystem sensitivity depends on the most sensitive species and protecting ecosystem structure protects community function" (Fairman et al, 1998).

Each NOEC is then divided by a safety factor to enable extrapolation from laboratory to field, acute to chronic effects and for inter and intra-species variation. The size of the safety factor varies according to the number and type of data available. Table 17 provides the aquatic risk assessment safety factors proposed in the EC Technical Guidance Document (EC, 1996). Ideally, the PNEC should be calculated from chronic toxicity tests relating to survival, growth and reproduction but such data are rarely available. In theory as more data become available the value of the PNEC should gradually decrease.

Table 17. Safety factors for generating PNECS

	Safety Factor
At least one short-term L(E)C50 from each of three trophic levels of the base-set (fish, daphnia and algae)	1000
One long-term NOEC (either fish or daphnia)	100
Two long-term NOECs from species representing teo trophic levels (fish and/or dahphnia and/or algae)	50
Long-term NOECs from at least three species (normally fish, daphnia and algae) representing three trophic levels	10
Field data or model ecosystems	Reviewed on a case by case basis

7.1.2.2.3 Toxicity Potential Score Discussion

Figure 29 shows the difference in component Toxicity Potential Score between the three selected suppliers. It is clearly evident that human toxicity dominates each score. This means that the masses of one or more of the "hazardous" materials within each component exceed(s) the OHLV(s) with greater orders of magnitude than they exceed the PNEC(s). The masses of many substances may also be lower than the OHLV or the PNEC. If an alternative human toxicity factor were used in the calculation such as Inhalatory Human Limit Value a different result would be obtained because substances exert different effects according to the exposure route. This is also true for ecotoxicity. The use of terrestrial or sedimentary PNECs would result in different comparative toxicities between substances. This exemplifies the problems associated with the selection and application of factors in any form of impact assessment. The main principle is to select factors for sound reasons and maintain consistency in their application. It is acknowledged that in isolation the Toxicity Potential Score is meaningless. It has to be used in a comparative context.

Figure 29 shows clearly that the PLCC 44 component provided by supplier 3 has the least potential toxicity and that human toxicity potential dominates the overall toxicity score. The data provided in Table 15 and Figures 30 and 31 show that the substances dominating the Human Toxicity Potential Scores and the Ecotoxicity Potential Scores are antimony and copper respectively. Antimony constitutes between 87 and 92 percent of the Human Toxicity Potential Score (depending on the supplier) and between 4 and 9 percent of the mass of hazardous substances present in the component.

Copper constitutes 99 percent of the Ecotoxicity Potential Score for all suppliers and between 84 and 95 percent of the mass of hazardous substances present in the component. From these results, in theory, the removal or substitution of antimony and copper from the component would result in a dramatic improvement in toxicity score.

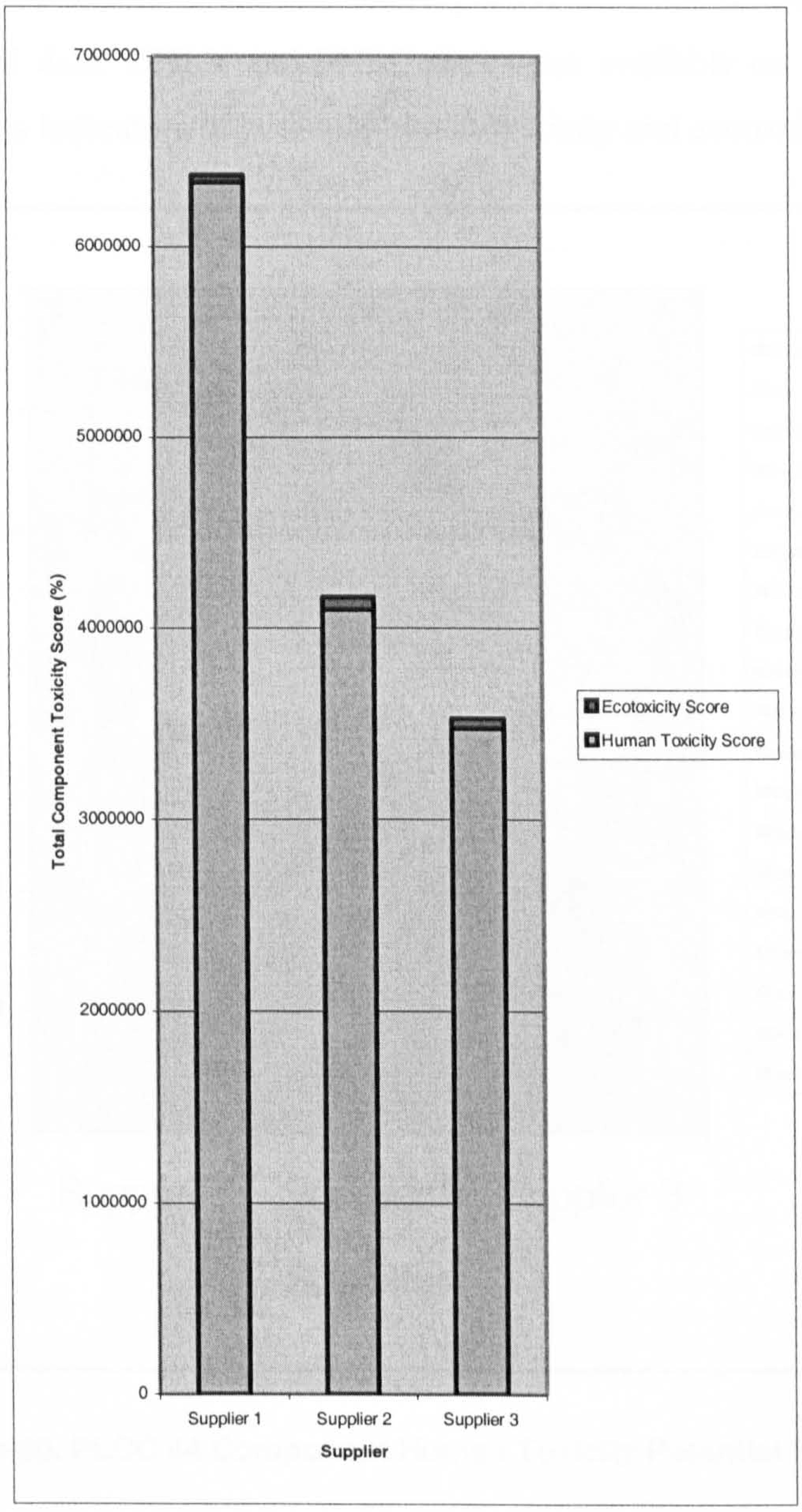


Figure 29. PLCC 44 Component Toxicity Potential Scores

There are several issues associated with the calculation and use of the Toxicity Potential Score. Both the Human Toxicity Score and the Ecotoxicity Score rely on individual factors. Thus the use of OHLVs does not take into consideration varying toxic effects that may be caused through human inhalation or exposure through the skin. Aquatic PNECs do not consider toxic effects through other media such as soil and air.

The selection of which factors to use and the respective indicator substances is influenced by the availability of data. OHLV and PNEC data were available on the majority of the substances selected as indicators of potential human toxicity and ecotoxicity but not all.

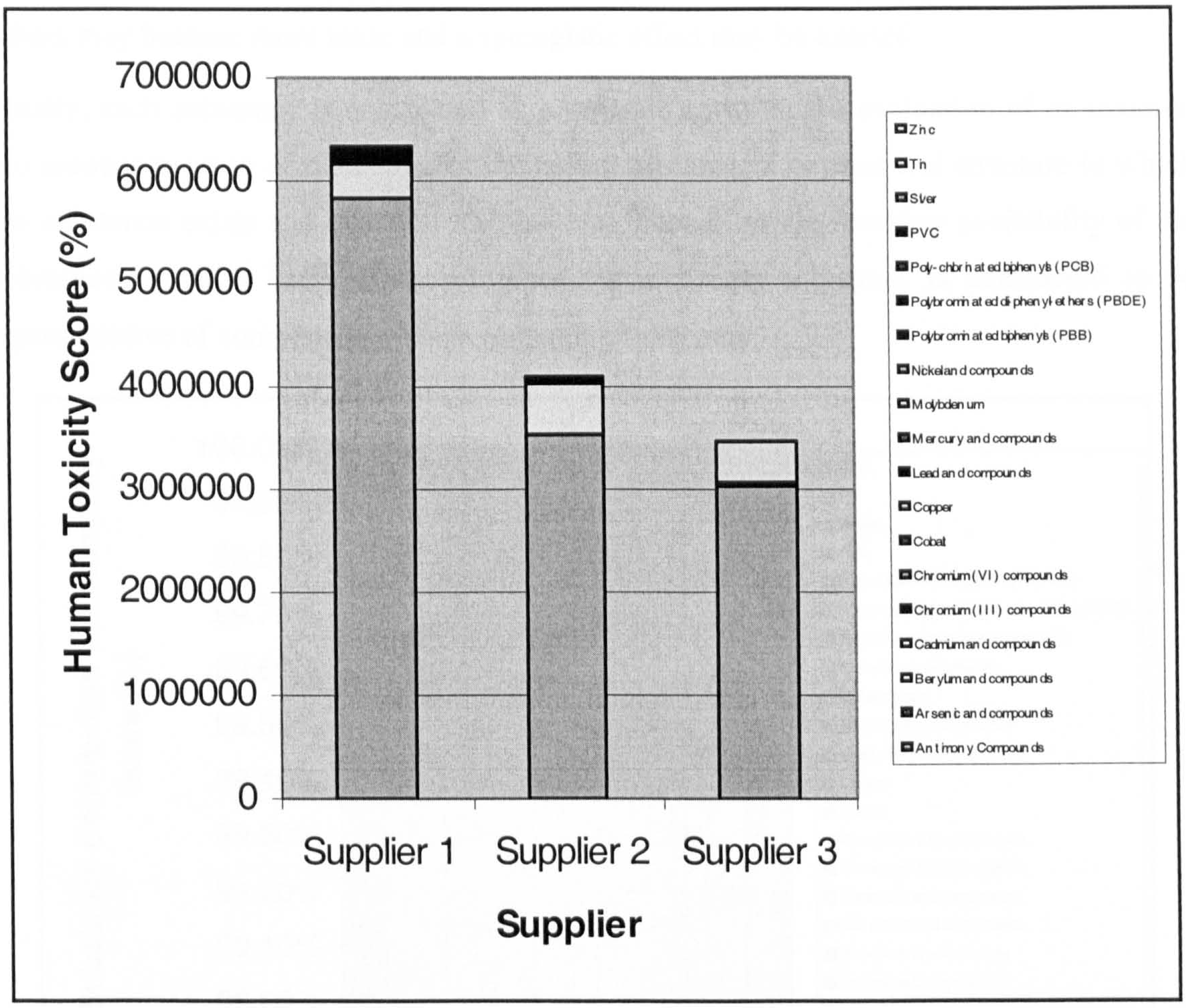


Figure 30. PLCC 44 Component Human Toxicity Potential Scores

No account has been taken of exposure mechanisms that greatly influence both the human toxicity and ecotoxicity potential of a substance. The toxicity potential is indicative of the inherent hazard of the substance and thus provides an indication of the potential for the substance to be harmful to humans or the environment at end-of-life and particularly if disposed of to landfill. Because the end-of-life scenario for the electronic equipment and thus electronic components is unknown it is difficult and wholly inaccurate to incorporate receiving media and fate and transport modelling into the toxicity evaluation. It is acknowledged, however, that exposure mechanisms will have a significant impact on the availability of the substance to cause harm. Processes occurring in the environment such as bio-degradation and inter-media transport and particularly the interaction of substances with one another all alter and affect the toxicity of the substance. Some substances may become less toxic in combination with others or under certain environmental conditions, others may become more toxic and a synergistic effect may be exerted.

Finally, each substance is considered as a separate entity in the evaluation of its toxicity. No account is taken of the nature of the bound mechanical or chemical structure in which the substance exists and that will also have an impact on the resulting availability of the substance to cause harm. Each substance, as a toxicity indicator, is considered to be representative of compounds of each respective substance.

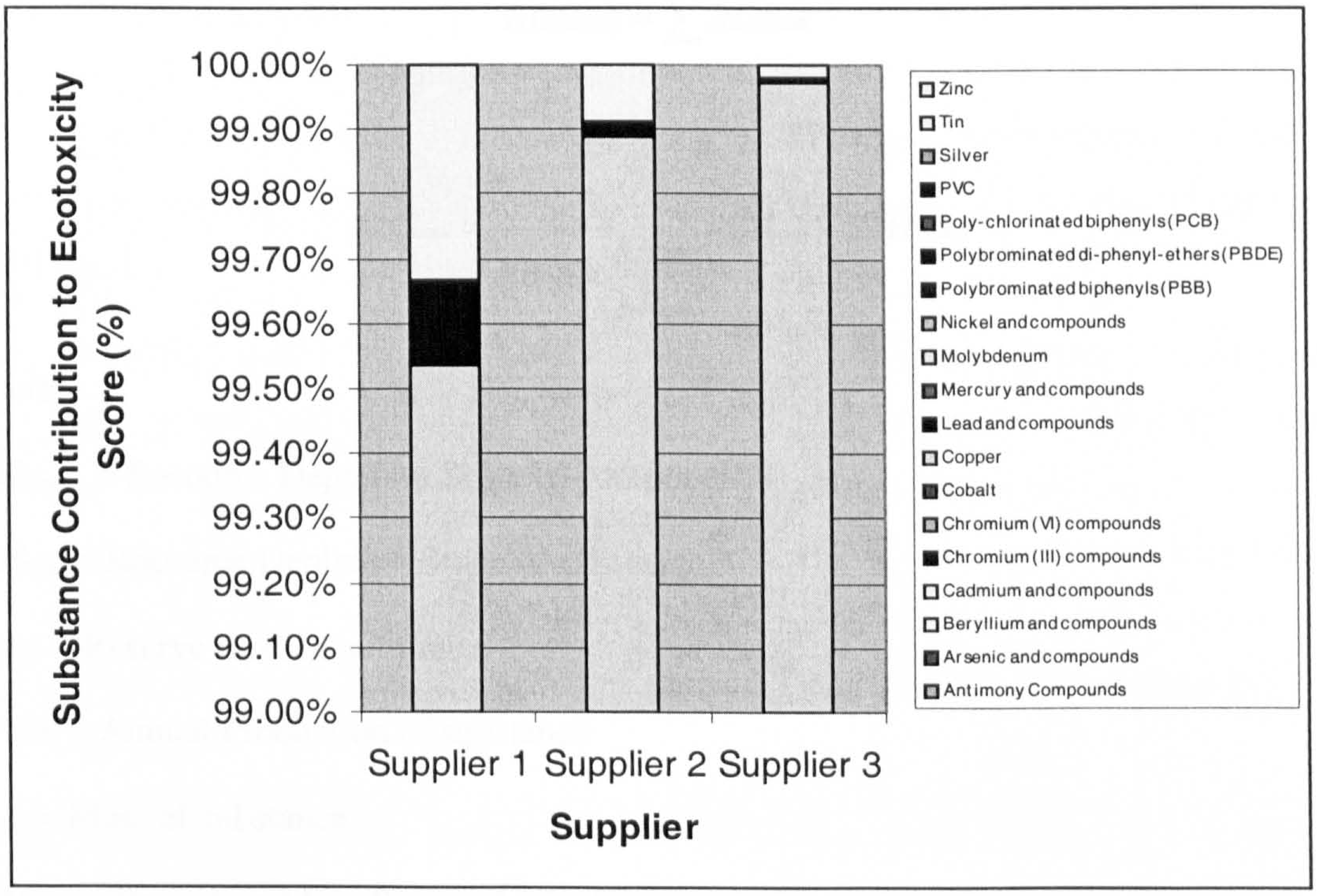


Figure 31. Substance Contribution to Ecotoxicity Score

Level 2 eco-evaluations could be conducted at the component qualification stage immediately on receipt of the material declaration. The Toxicity Potential Score could form part of the technology assessment and be entered into the component database along with a level 1 compliance statement. The toxicity performance of the component could then be integrated into the decision-making process for supplier approval and selection for production.

Certain substances could also be penalised further through the application of weighting factors to the toxicity scores to take into consideration the imminent restriction of the use of certain substances by regulation and the inhibiting nature of certain substances in the smelting/recycling process.

7.1.2.3 Level 3 Eco-evaluations

A level 3 eco-evaluation consists of levels 1 and 2 and also the inclusion of a Resource Depletion Score for each component provided by each supplier.

The Resource Depletion Score is calculated according to the following equations:

$$RDS_{comp} = \sum RDS_{sub}$$

and

$$RDS_{sub} = \frac{1}{RB_{sub} \times \frac{RB_{sub}}{AP_{sub}}} \times (M_{sub} - RMP_{sub})$$

Where:

RDS_{comp} = Resource Depletion Score of component

RDS_{sub} = Resource Depletion Score of substance

RB_{sub} = Reserve Base of substance

APsub = Annual Production of substance

M_{sub} = Mass of substance

RMP_{sub} = Recycling Mass Potential of substance

The objective is to generate a quantitative indicator of the performance of the component in terms of the depletion of abiotic resources and potential recyclability. The resource depletion factor was published by Heijungs et al (1992). The RDS of the component is calculated by subtracting any potential mass of the substance that could be recycled economically from the mass of the substance present in the component and multiplying the result by the inverse of the current or selected reserve base multiplied by the number of years left of the reserve base at current production rates for the respective substance. The RDS of the each substance is then aggregated to provide an overall score for the component. The units are y^{-1}. The lower the score the superior the performance.

Research undertaken and discussions with experts in the field of electronics recycling has revealed that currently only a limited number of metals within electronic components provide a positive value on granulation and smelting of the populated printed circuit boards at product end-of-life. The metals deemed to be economically recyclable in the derivation of the RDS are gold, silver, copper, platinum and palladium. These are the metals that copper smelting companies such as Noranda, Demet Deutsche Edelmetall and Union Minière typically pay a return on. Recycling yield returns have also been incorporated into the calculation based on information provided by Noranda. It is not always economically viable to attempt to extract one hundred percent of the precious metal present in a quantity of material for smelt. Typical economic yields range between 85 and 97 percent depending on the metal.

"Some recyclers will strip the visible precious metals using cyanide solution, then incinerate the remainder into an ash which they then melt into an ingot form. The "waste" slag from melting contains some metals. The slag sometimes can be processed at a smelter for further recovery. The ingot may be smelted or sent directly to a precious metal refinery, depending on the content. Circuit boards that are smelted directly are generally low grade or regular grade, where the costs of stripping, incinerating, melting etc. are not justified" (Bouma, 2000).

As for toxicity indicators a number of substances have been selected as indicators of resource depletion. The substances and their respective reserve bases are provided in Table 18. Only metals have been selected as data are readily available, allocation for organic substances would be particularly complex and some materials such as silica are considered to have virtually infinite reserves. Reserve base data have been sourced from the United States Geological Survey Mineral Commodity Summaries 2000. Reserve Base is defined as:

> "That part of an identified resource that meets specific minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness and depth. The reserve base is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The reserve base includes those resources that are currently economic (reserves), marginally economic (marginal reserves), and some of those that are currently sub economic (sub economic resources)"(U.S. Geological Survey, 1980).

It is acknowledged that a number of definitions exist regarding mineral resource availability but the classification developed by the U.S. Geological Survey is recognised as the standard and by using reserve base data the majority of resource sub-categories have been included. There are, of course, undiscovered resources, the existence of which are only postulated and cannot be included in the calculation.

Figure 32 shows the comparative Resource Depletion Scores for the three suppliers of the PLCC 44 component incorporating recycling yields of copper, gold, silver, Platinum and Palladium of 95, 96.5, 95, 86 and 86 percent respectively.

Table 18. Resource Depletion Indicator Substances and Reserve Base

Mineral	Reserve Base (kg)
Aluminium	3.4E+13
Antimony	3200000000
Arsenic	1245000000
Cadmium	1200000000
Chromium	7.5E+12
Copper	6.5E+11
Gold	77000000
Lead	1.43E+11
Magnesium	3.4E+12
Mercury	240000000
Molybdenum	12000000000

Nickel	1.4E+11
Palladium	39000000
Platinum	39000000
Silver	420000000
Tin	12000000000
Zinc	4.3E+11

The units of the Resource Depletion Scores are inverse years and it is clearly seen that Supplier 3 has the superior performance of the three. The greatest substance contributor to the component Resource Depletion Score for each supplier when recycling of the five key metals takes place is antimony (the masses of silver and antimony are much greater in the component material profiles from supplier 1 compared to suppliers 2 and 3). However, if the five key metals are not recycled the Resource Depletion profile is very different with gold and silver dominating the component Resource Depletion Score along with Antimony (see Figure 33). Incorporating both the size of the reserve base and the current production (inferred use) rate in the index addresses some of the limitations of other indices as discussed in the next section.

7.1.2.3.1 Resource Depletion Factors

One of the first indicators of contribution to resource depletion for use in life cycle assessment was the ratio of substance emitted or discharged to the reserve base (Heijungs et al, 1992):

$$RD = \frac{M_{sub}}{RB_{sub}}$$

Where:

RD = Resource Depletion

M_{sub} = Mass of substance

Rb_{sub} = Reserve Base of substance

This index generates a ratio or a percentage. However, this ratio does not consider the rate at which the resource is being depleted. Two similar sized reserve bases could be being used at very different rates and one would therefore be depleted considerably more quickly than the other. An alternative indicator is the "remaining years of use". The reserve base is divided by the total worldwide production (inferring consumption or use):

$$RD = \frac{1}{\frac{RB}{AP}} \times Msub$$

Where:

RD = Resource Depletion

RB = Reserve Base

AP = Annual Production

M_{sub} = Mass of substance

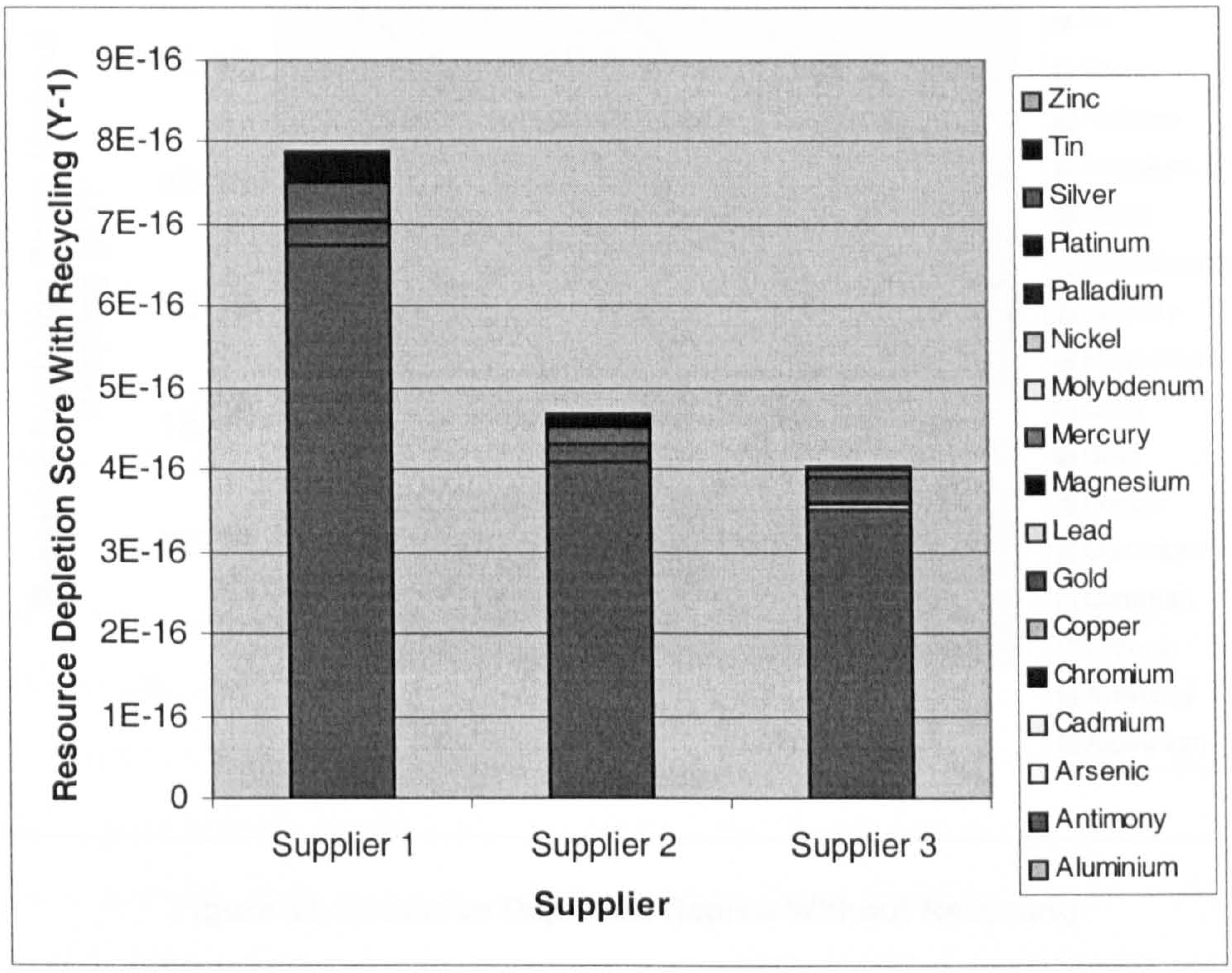


Figure 32. Resource Depletion Scores

It represents the number of years for which current reserves will suffice at the present production (consumption) level. However, this indicator does not correctly account for the size of the reserve base. Two resources with the same remaining number of years will have the same indices irrespective of the size of the reserve base (e.g. 1 kg as opposed to 1000000 kg).

Although incorporating both reserve base size and rate of use into the index addresses the problems associated with their individual application, the use of two parameters doubles the uncertainty factor as the data requirement is doubled. Uncertainties exist in the generation of accurate reserve base estimates and also annual production and consumption rates.

For the purposes of level 3 and 4 eco-evaluations any of the above equations could be used but the first is considered the most accurate and provides the most comprehensive results if the data are available.

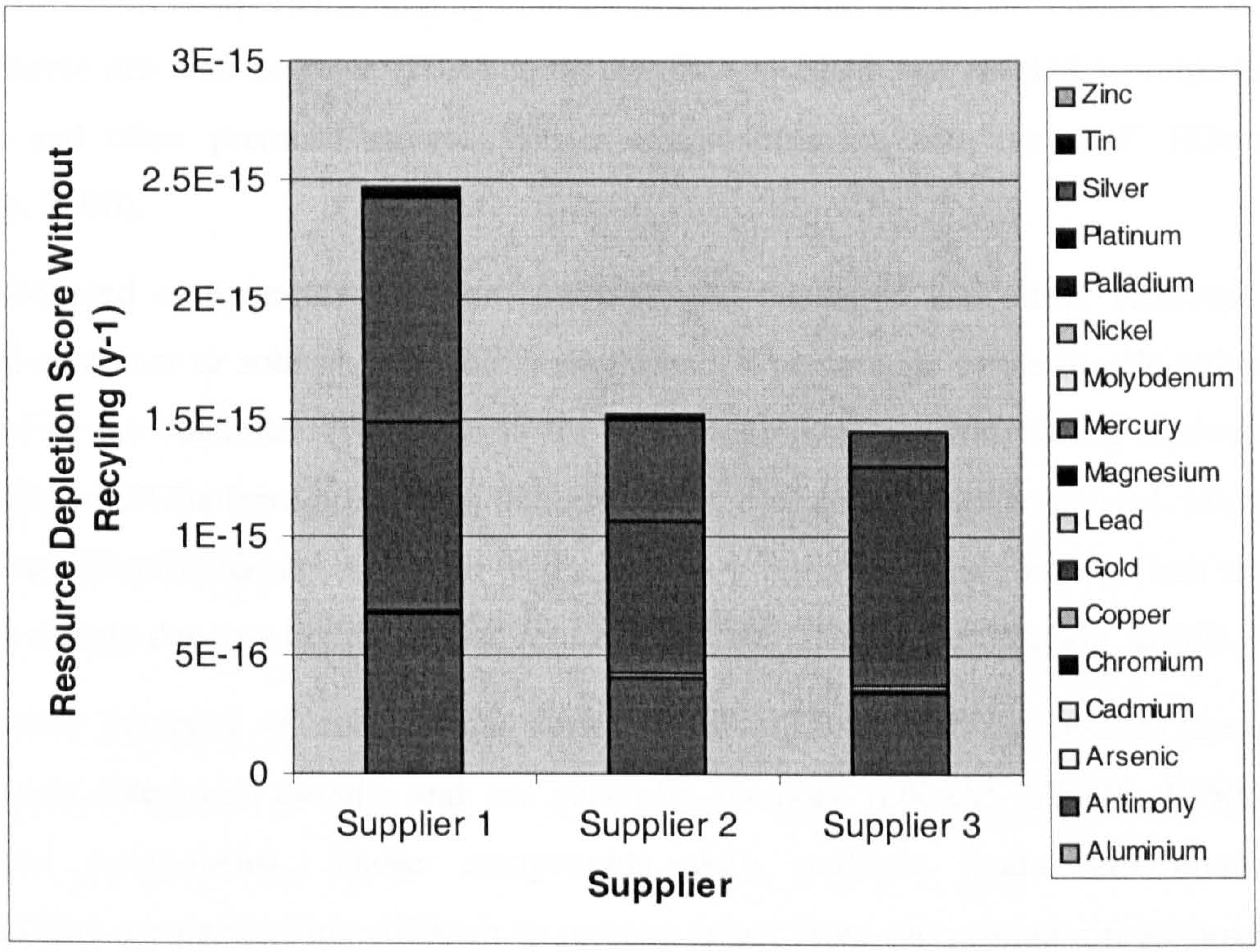


Figure 33. Resource Depletion Scores Without Recycling

7.1.2.3.2 Component Re-use

The first end-of-life option for consideration in a product life cycle management programme for any electronic equipment is re-use of the product in its existing form. If product re-use is not possible the next level of the hierarchy is component re-use. The final option is shredding and smelting of the populated circuit board with recovery of metals of value such as copper, gold, silver, platinum and palladium. The resource depletion potential calculations used in level 3 and 4 eco-evaluations assume shredding and smelting as a worse case scenario.

Component re-use is becoming more of a viable option as markets begin to develop globally despite slow growth in the United Kingdom as "people perceive them as being second-hand components" (McLean cited in Electronics Weekly, 2000). Strong markets are developing in Asia and the United States. Newhouse Electronics is one of several asset recovery or recycling companies in the UK (others include Bruce Metals, Mann Organisation and Precious Metal Industries) that are experiencing growth in the re-used components business.

"All marketable components, mostly ICs, are removed from the PCBs. Custom or obsolete components are also popular. The boards are then crushed and refined to remove gold, copper and other precious metals. Plastic components are also recycled" (Electronics Weekly, 2000).

The recovered components are then re-tinned and packaged and either returned to the original customer or sold on available markets with a percentage of the re-sale value being returned to the customer. The majority of the components currently being recovered are from rejected PCBs from production facilities and therefore have not been used. Many from Newhouse Electronics are not even tested and they report a failure rate of less than one percent mainly due to a highly refined removal process (Electronics Weekly, 2000).

The re-use potential of components varies greatly. Those that are re-used are almost exclusively integrated circuits and are generally memory (DRAM, SRAM, EPROM) or processor components. Those components with multiple leads and connections (e.g.PLCCs) are particularly difficult to remove intact from the printed circuit board. The value of components varies greatly as market demand and price fluctuates widely but the range is from a few cents per item to thirty or forty dollars per item (Wolle, 2001). The value will be mainly influenced by the age of the component, rarity (some older less available components attract a premium) and technology (analogue components apparently date less quickly than digital (Farrell, 2001)).

Research was carried out to determine the feasibility of generating predictive re-sell values for components that could be entered into component databases and used to create a re-sell profile for the final product. Discussions with recycling companies (Noranda, Demet Deutsche Edelmetall and Union Minière – personal communication) though have suggested that such an activity is not feasible because of the fluctuation in price. It is possible to predict, admittedly with some uncertainty, which component types will be likely to be of value at the predicted end-of-life of the electronic equipment. This information could be entered in the component database and those components potentially available for re-use can be withdrawn from the product resource depletion or recyclability calculation.

In terms of volume throughput and concentration of "valuable" components on PCBs, information technology equipment such as PCs and laptops are preferable for end-of-life processing. Telecommunications equipment varies much more dramatically in terms of component and material content and volume than information technology equipment. Components of re-sale value are generally scarcer and smaller in volume.

The situation is similar for potential revenue generation from PCB shredding and smelting of precious metals in that there is a wide differential in material content between PCBs with different functionality. Typically PCBs from mobile phones are richer in precious metals than those used in most other applications and hence yield greater value per tonne when shredded and smelted.

7.1.2.3.3 Combining Resource Depletion and Toxicity

Level 3 eco-evaluations integrate toxicity and resource depletion considerations. This is achieved through the application of Multi-Criteria Analysis (MCA) techniques including Multi-Criteria Decision Analysis (MCDA). The use of such techniques result in information that can be used in comparative option selection scenarios.

7.1.2.3.3.1 MCA

"MCA establishes preferences between options by reference to an explicit set of objectives that the decision making body has identified, and for which it has established measurable criteria to assess the extent to which the objectives have been achieved" (Department of Environment, Transport and the Regions, 2001).

"MCDA is both an approach and a set of techniques, with the goal of providing an overall ordering of options, form the most preferred to the least preferred option. The options may differ in the extent to which they achieve several objectives, and no one option will be obviously best in achieving all objectives. In addition, some conflict or trade-off is usually evident among the objectives" (Department of Environment, Transport and the Regions, 2001).

The objective of MCA in the context of the component eco-evaluation methodology is to provide a rational framework in a process to decide which supplier of an electronic component provides the component of preferred environmental choice. There is no question that elements of subjectivity enter into the MCDA process. However according to the DETR (2001), MCDA (as a form of MCA) does have a number of advantages over informal judgement unsupported by analysis:

- It is open and explicit;
- The choice of objectives and criteria that any decision making group may make are open to analysis and to change if they are felt to be inappropriate;
- Scores and weights, when used, are also explicit and are developed according to established techniques;
- It can provide an important means of communication, within the decision-making body and sometimes, later, between that body and the wider community; scores and weights are used, it provides an audit trail.

Two MCA approaches (dominance and the MCDA linear additive model) are proposed for integration into level 3 eco-evaluations and they have been selected on the basis of ease-of-use, appropriateness to the context of the decision-making process and the data available.

A standard feature of any MCA approach is the performance matrix or consequence table. Each row in the table describes one of the options that are being considered in the decision process. Each column represents a specific criterion that has been selected and that is considered important in the comparison of different options. The entries into each cell of the matrix are representations (numeric or bullet point scores) of the performance of each option with respect to each criterion. Table 19 shows the performance matrix for a level 3 eco-evaluation of the example PLCC 44 (no additional weighting has been applied in the Toxicity Potential Scores for substances earmarked for regulatory restriction or substances deleterious to the smelting process).

Table 19. Component Toxicity and Resource Depletion Potential Scores for Example PLCC44

	Component Toxicity Potential Score (%)	Component Resource Depletion Score (Y^{-1})
Supplier 1	6377761.668	7.8951E-16
Supplier 2	4162144.543	4.6917E-16
Supplier 3	3529369.019	4.0276E-16

Both the use of the dominance and the MCDA approach in MCA requires that "preferences associated with the consequences of the options are independent of each other from one criterion to the next" (DETR, 2001). This simply means that if preference scores can be assigned for the options on one criterion without knowing what the options' preference scores are on any of the other criteria the preferences are mutually independent. Thus, Toxicity Potential and Resource Depletion Potential are considered mutually preference independent.

For simple performance matrices it is possible for the decision-maker to interpret the data provided and come to a conclusion on the relative ranking of the options available without further analysis. Alternatively the decision-maker can check for the presence of dominance.

"Dominance occurs when one option performs as least as well as another on all criteria and strictly better than the other on at least one criterion. In principle, one option might dominate all others, but in practice this is unlikely" (DETR, 2001). Domination on all criteria is more likely to occur when a small number of criteria are being used in the assessment. In the PLCC 44 example Supplier 3 dominates both 1 and 2 as it has both a superior Toxicity Potential Score and a superior Resource Depletion Score. In terms of eco-evaluation Supplier 3 is the preferred option and this information can be added to the component qualification process to be considered in the approval process along with the other component qualification criteria described in section 7.1.1.2.

However, if dominance does not exist, a different approach is required such as MCDA.

MCDA also requires the generation of a performance matrix and then scales are constructed to represent the preferences for each criterion, the scales are weighted for their relative importance and then weighted averages are calculated across the preference scales.

For the construction of scales it is conventional to allocate a value score for each criterion between 0 and 100 on an interval scale. This can be conducted on a global or local scale. A local scale involves the allocation of scores of 0 and 100 for the performance levels for each criteria of the least and most preferred option respectively. A global scale involves the allocation of scores of 0 and 100 to performance scores that are beyond the existing range of performance scores. They represent the worst and best possible levels of performance that could be reasonable encountered in the given scenario. Once the extremes of the scale have been identified the preference scores for each option are converted to values scores on the 0 to 100 scale. It may be necessary to use the inverse performance scores of criteria to ensure that high preference is indicated by a high value score (this is the case for both Toxicity Potential and Resource Depletion). Also in this case the value functions are assumed to be linear i.e. a doubling in toxicity score represents a perceived doubling in toxicity potential.

Because of the small number of criteria being used in the eco-evaluation methodology it was decided to use global scaling and to calculate high and low limits as ten percent of the range of the scores of each option for each criterion. End points were constructed to ensure zeros were not generated. The percentage range of the score is arbitrary. The performance scores and the corresponding value scores for the PLCC 44 are provided in Table 20.

Table 20. Value Scores

	Component Toxicity Potential Score (%)	Component Toxicity Potential Value Score	Component Resource Depletion Score (Y^{-1})	Resource Depletion Potential Value Score
End Point 1	6662600.868	0.00	0.00000000000000079338	0.00
Supplier 1	6377761.668	8.33	0.00000000000000078951	0.98
Supplier 2	4162144.543	73.15	0.00000000000000046917	82.19
Supplier 3	3529369.019	91.67	0.00000000000000040276	99.02
End Point 2	3244530.019	100.00	0.00000000000000039889	100.00

The next stage involves the generation of appropriate weighting scores for each criteria and multiplying them with each option value score and summing the results to form a weighted average for each option. The derivation of weights is highly subjective. Two key factors are generally considered:

- The range of difference of the options; and
- The significance of the difference.

The calculation of weights is typically achieved in MCDA by using the swing weighting method and the nominal group technique. The swing-weighting method is based on "comparison of differences: how does the swing from 0 to 100 on one preference scale compare to the 0 to 100 swing on another scale" (DETR, 2001). The nominal group technique involves a selected group of individuals comparing the swing of one criterion with the swing of the others based upon the individuals' judgement. The final weights are determined through discussion amongst the group. For eco-valuations the agreed weights will vary from group to group and company to company.

A weight of 0.6 was allocated to Toxicity Potential and 0.4 to Resource Depletion Potential in the development of level 3 eco-evaluations in the present research project. These weights reflect the ranges (very similar) and the fact that toxicity is considered significantly more important within the telecommunications industry than resource depletion at this point in time.

The weighted average scores for the PLCC 44 are provided in Table 21.

Table 21. Weighted Averages for PLCC 44 Example

	Component Toxicity Potential Weighted Score	Component Resource Depletion Weighted Score	Total Weighted Average
Supplier 1	4.9999993432	0.3921568627	5.3921562059
Supplier 2	43.8924136239	32.8740002788	76.7664139027
Supplier 3	55.0000041676	39.6078431373	94.6078473048

Because Supplier 3 is dominant is this scenario it clearly emerges with a higher weighted average score than supplier 1 or 2 using two criteria.

7.1.2.3.4 Level 3 Eco-evaluation Summary

Level 3 eco-evaluations incorporate the consideration of resource depletion into the selection process for suppliers of components. The objective is to provide a decision framework for supplier selection and also to provide information for product end-of-life decision-making. The formation of a performance matrix allows dominance to be checked first. If one option out-performs all the others on both criteria it is clearly the preferred option. If dominance does not exist then the MCDA linear additive model is applied. The result is the identification of a preferred option. This eco-performance information could be integrated into the commodity introduction process and/or the component sourcing process during manufacture. It is also possible to input the weighted average score for a given component from a specific supplier into the component database for comparison with another supplier at a later date as long as the weighting is consistent.

In addition to a component level 3 eco-evaluation score being added to the component database information such as percentage of recyclable materials (five metals specified above or others as identified) and perhaps potential gross value could also be added. This information could be collated and used to generate recyclability profiles on Nortel Networks products. In the PLCC 44 example scenario the components from suppliers 1,2 and 3 have calculated recyclability values (predicted yield percentages) of 20.45, 30.03 and 23.44 respectively.

It is acknowledged that the weighted average score is particularly sensitive to changes in the weights used. Issues of uncertainty concerning the methodologies are discussed in 7.1.3.

7.1.2.4 Level 4 Eco-evaluations

Level 4 eco-evaluations consist of the parameters included in levels 1 to 3 and also consider the suppliers' commitment to product environmental improvement and information provision through the use of section B SEAP scores (see Chapter 6).

7.1.2.4.1 Methodology

The methodology enables the evaluation to be broader in scope and to include consideration of such issues as commitment to ecodesign and the provision of hazardous material and LCA data. The questions developed to evaluate product environmental performance in SEAP are provided in Table 22. The respective SEAP section B scores for each supplier are provided in Table 23 expressed as percentages of the total possible score.

Table 22.
SEAP Product Environmental Performance Questions and Maximum Scores

	SEAP Part B Product Environmental Performance (for all products)	Score	Score
1	Section 1 Ecolabelling and Product Takeback	Yes	No
1.1	Is the product marked with any voluntary eco-labelling (if applicable)?	5	0
1.2	Does the company have a product takeback programme in place or is one being developed (please specify in comments section).	5	0
2	Section 2 Manufacturing		
2.1	Do the activities of your company require regulatory licensing?	0	5

2.2	Are hazardous materials as listed in Form A1 (tab below) used in the manufacturing of your products?	-20	20
2.3	Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? If you answered no to 2.2 above just answer no to this question.	20	0
3	Section 3 Use		
3.1	During the use of the product are any of the materials listed in Form A1 emitted?	-20	20
4	Section 4 Eco-Design		
4.1	Have any of the following eco-design strategies been used in the design process of the product?		
	Hazardous material avoidance (see section 5.2) in component structure, coatings.	5	0
	Re-usability	5	0
	Marking of plastics	5	0
	Recycled material content	5	0
	Recyclability	5	0
	Thermal convection reduction	5	0
	Disassembly	5	0
	Packaging minimisation	5	0
	Transportation packaging re-use (take-back)	5	0
	Transportation packaging recycled material content	5	0
	Avoidance of coatings and bleaches in transportation packaging	5	0
4.2	Does the company have or intend to have a formalised eco-design programme that is part of the product development process?	50	0
5	Section 5 Product Environmental Information		
	The answers to the following questions will provide Nortel Networks with an indication of the supplier's ability to provide detailed product environmental performance data. If the supplier answers yes to any of the questions, they are requested to use Form A1 for the provision of product material composition data, the indication of the use and phasing out of hazardous materials in the manufacturing process and emissions during use. LCA data should be provided in electronic format if available.		
5.1	Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete component materials declaration in Form A1)	70	0
5.2	If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are presently considered by Nortel Networks to be those on the list in Form A1.(Please complete the hazardous material declaration in Form A1 for each component)	30	0
5.3	Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel Networks? (Specify the products and provide the data in electronic format if available:)	20	0
5.4	Can the supplier provide guiding information on end-of-life management for the supplied products?	10	0

Table 23. PLCC 44 Supplier SEAP B Scores

	SEAP B Score (%)
Supplier 1	74.14
Supplier 2	75.86
Supplier 3	34.48

It is clearly seen that Supplier 3 scores particularly poorly with Suppliers 1 and 2 being similar.

When SEAP B scores are also considered in the eco-evaluation the allocated weightings have to be re-calculated. Again a combined total weighting of one unit is used. The proposed calculated weights for level 4 eco-evaluations are provided in Table 24 and the weighted averages for the PLCC 44 suppliers in Table 25. In the calculation of the weights both Toxicity Potential and the SEAP B Score were considered to be equally important and Resource Depletion half as important. The weights reflect the supply chain issues that are considered to have the greatest impact on the product life cycle management performance of telecommunications products. Toxicity is a core issue in terms of Nortel Networks customer concern and also legislation. The SEAP B score provides an indication of the commitment of the supplier to the development of products with improved environmental performance through the application of ecodesign considerations and a willingness to communicate appropriate product environmental information.

Table 24. Weighting factors

	Weighting Factor
Toxicity Potential Score	0.4
Resource Depletion Score	0.2
SEAP B Score	0.4

Table 25. Level 4 Eco-Evaluation PLCC 44 Total Weighted Average Scores

	Component Toxicity Potential Weighted Score	Component Resource Depletion Score Weighted Score	SEAP Section B Weighted Score	Total Weighted Average
Supplier 1	3.333332896	0.196078431	36.663866	40.193277
Supplier 2	29.26160908	16.43700014	38.109244	83.807853
Supplier 3	36.66666945	19.80392157	3.3361345	59.806725

The Level 4 eco-evaluation for the example PLCC 44s results in Supplier 2 emerging as the preferred option. The evaluation is heavily influenced by the poor performance of Supplier 3 on the SEAP B assessment.

7.1.2.4.1 Level 4 Eco-evaluation Summary

The principles of Level 4 Eco-evaluations are identical to Level 3. Dominance is considered first and then MCDA is used to generate a preferred option. The weighted average scores could be integrated into the commodity introduction process and/or the component sourcing process during manufacture and could also be added to the component database independently as long as reference is made to the eco-evaluation methodology applied. The SEAP B score could be replaced by any form of quantitative supplier assessment process.

7.1.3 Eco-evaluation of Electronics Components Discussion

The hypothesis central to the development of an electronics component eco-evaluation methodology is that differentiation between suppliers can be achieved through product environmental performance. The findings from the research presented in Chapter 6 suggest that the hypothesis is true. There exists a wide variation in the environmental performance of component suppliers of the telecommunications industry and it is suggested that methods of supplier environmental assessment developed by different telecommunications companies would also prove this to be the case. In addition it is suggested that the use of generic component material composition data in ecodesign is inaccurate and fraught with uncertainty (see Document C2.4).

Methods to assess suppliers' environmental performance across the telecommunications industry are typically in the form of a scored questionnaire similar to the SEAP questionnaire. The assessing company will have several reasons for conducting the assessment but the underlying aim tends to be qualification to a minimum requirement or standard rather than the use of the results for any positive discrimination between suppliers in the selection process. An alternative approach is to reward suppliers with demonstrated superior performance and to integrate it into the supplier selection process.

The eco-evaluation methodology detailed in this chapter attempts to go beyond the standard supplier assessment approach and focus on product life cycle management issues.

The eco-evaluation hierarchy from Levels 1 to 4 provides a tiered approach to implementation that reflects the type and quantity of data available and the objectives of the implementers. Data availability is fundamental to any eco-evaluation level.

Level 1 requires relatively little data to ensure regulatory compliance. Level 2 requires a declaration of hazardous material content. Levels 3 and 4 require a comprehensive product material declaration. Level 1 declarations are relatively simple to provide and negative declarations are, therefore, currently the preferred option for suppliers. Capturing comprehensive product material content data from component suppliers is currently extremely difficult. Few suppliers have systems in place to provide this type of data. Only two suppliers included in the SEAP pilot study (detailed in Chapter 6) were proactively investigating methods and systems to provide customers with detailed material data. Many component suppliers and telecommunications product manufacturers question the need to provide these type of data because of the resources required and scepticism concerning the value of doing so. No regulations are currently in place to require the provision of product material data although this may change with the introduction of the WEEE and EEE Directives.

Ultimately, it is argued, making informed decisions regarding component selection in ecodesign and product life cycle management, and the generation of detailed and accurate product material profiles or product environmental profiles for telecommunications products requires comprehensive material data from the supply chain. The step taken by EICTA to develop an industry standard approach for supplier product material declarations is recognition of the significance of the issue. It remains to be seen how effective and successful such a programme will be.

Another issue to recognise as a potential problem is the quality of data provided. It is imperative that suppliers also provide details of a transparent methodology that has been used to generate the material data content including any error and uncertainty considerations. Ideally, with the introduction of a standard format for component material declarations a standard methodology for data generation should also be introduced.

Large errors and significant uncertainty within the data could completely negate the possibility of a meaningful and useable answer emerging from the eco-evaluation. Because the quantities of materials are very small and the dimensions of the components varies from two millimetres to several centimetres there is potential for errors in the data to be greater than the difference in material mass declarations for each material between suppliers. An accurate and standard methodology for measuring materials is, therefore, prerequisite. An examination of suitable measurement methods and a proposal for a data validation method were conducted as an MSc research project under supervision of the RE (details are provided in Chapter 6).

LCA research on electronics products has concluded that the dominant life cycle phase for environmental impacts is the use phase (Francis, 1999). The cause of the impacts being the energy consumed by the product. In terms of resource allocation and prioritising areas for improvement it is prudent to focus on reducing energy consumption as an initial step. Some environmental specialists may question the value of allocating resources in the pursuit of material data if the benefits are not significant in terms of improving product environmental performance. The quickest and greatest overall improvements in environmental performance may well be achieved by reducing energy consumption in the use phase but a comprehensive approach to product life cycle management and a commitment to the development of more benign products and services, dematerialisation and even sustainability, requires improved materials and product management. Increasing regulation and customer concern regarding hazardous materials also means that materials are a priority issue. In addition, the imminent requirement to recover, re-use and recycle electronics products requires sound materials knowledge and management to optimise economic value.

Level 4 eco-evaluations use three criteria to assess components from suppliers. These criteria were selected because of their generally recognised importance in terms of environmental impact in the electronics industry. It is acknowledged that other criteria pertaining to other environmental impacts such as energy consumption and materials used during the manufacture of electronic components could also have been used. However, the inclusion of such criteria in any eco-evaluation would require the capture of even more detailed data necessitating a mass balance or life cycle inventory approach. Form A1 (the product data capture element of SEAP (see Chapter 6)) has fields for the provision of information on hazardous materials used during manufacture. Rather than being used as an integral component of the assessment it is envisaged that this information could be used to track eco-technology initiatives such as process material substitution or phase out.

The capturing of component material composition data allied with information on a supplier's environmental programmes allows an appraisal to be made. More detailed data would aid the decision-making process or at least make it more informed but capturing such data would be even more difficult and resource intensive (see Document C2.4). Basing decisions upon the criteria used in Level 4 eco-evaluations is considered a logical compromise that advances product life cycle management with a modicum of investment in data capture without demanding full life cycle inventory data.

In summary it is recommended that component eco-evaluation is integrated into the component or technology qualification process. Such evaluations are particularly suited to the new commodity introduction process that forms a part of the product development process at Nortel Networks. In this context component and supplier product related eco-performance can become an established element of the decision-making process for supplier selection. Such a step could also initiate a drive towards the serious consideration of product eco-performance in the context of ISO 14001 continual improvement and a recognition of supply base environmental performance being a significant environmental aspect, with product eco-innovation and a focus on materials management, providing a vehicle for product-oriented continual improvement.

7.2 Product Material Profile Generation for Telecommunications Products

The second hypothesis driving the pursuit of product material content data is that only supplier-specific material data on components and electronic sub-assemblies can provide accurate information for generating Nortel Networks product material profiles.

This hypothesis suggests that generic data available in some commercially available databases and ecodesign software packages is not sufficient to successfully achieve this objective (see documents C2.1 and C2.4). Only a limited amount of information exists on a relatively small number and type of components. Any environmental impact modelling that is conducted at the electronics product level and based on these data would be particularly restricted and the results potentially inaccurate and misleading. Ecobilan, the developers of the EIME ecodesign software do recognise the importance of capturing supplier data and enable these data to be added to the tool.

The generation of Nortel Networks product material profiles could serve two main purposes: the provision of product material content data to customers and the provision of information for product management decision-making at end-of-life.

The increasingly more demanding requirements of customers for product environmental information have been detailed in Chapter 5. The general trend in network operators' supplier environmental assessments has been from management system related issues to hazardous material and total material content of products and product eco-performance in general. It is currently very difficult state accurately exactly which substances are present in a product without detailed information from the supply chain. The only other alternative is to attempt to generate some form of material profile using average or generic data.

If component and sub-assembly material content data could be collated and converted into product material profiles it would be possible to generate some indication of the potential end-of-life economic value of the product in terms of re-use or recyclability. This would allow for a total life cycle costing approach to be adopted during the new product introduction process. Investigations were conducted on obtaining values for used components and materials. Because of the huge fluctuations in the markets and their ad hoc nature it is impossible to obtain accurate values. However, components that are likely to be re-usable and materials that are likely to be economically recyclable can be identified from a product bill of materials and a material profile. An estimate of the potential value of the product in a given time frame could then be obtained.

Research was conducted to investigate the feasibility of collating component and sub-assembly material content information into a Nortel Networks product material profile, assuming the data were available. The research focused on three Nortel Networks products and the processes in place for managing and tracking product releases and bill of materials.

7.2.1 Product Data Management Processes

There are three primary database types within Nortel Networks that house all the available product-oriented data including components and assembled products. Components, once qualified, are coded and have their details entered into a database system that is currently called partSMart. The information captured includes technical information, qualification history and qualified suppliers. Components are selected from this database during product design. Any new components being introduced through the design process will be subject to the qualification process and their details subsequently entered into partSMart. The qualification and databasing process is dynamic and constantly being reviewed and changed to meet the requirements of the company.

During the design process a bill of materials (BoM) or parts list is generated for each product. Depending on the complexity of the product it may contain from 150 components or less to many thousands of components and many sub-assemblies. This results in the BoM either being straightforward or rather complex and multi-layered. The product may have a super BoM that only lists the codes of the main sub-assemblies. Each sub-assembly would then have its own BoM.

Each BoM is version controlled. Each version being associated with a version release of the product that is due to some form of engineering change being made. An engineering change may be the replacement of a component or a design modification. The BoMs are version controlled in the central product database (the Integrated Engineering Database or IEDB). The IEDB can be interrogated for a range of product and part information using specific software. The IEDB is the main source of Nortel Networks product data. Each product is given a unique identifying code and BoMs are specific to that particular release and code of the product.

For products such as the M7310 telephone and the i2004 telephone (two of the example products used in this section) product releases and BoMs are relatively easy to track. However with more complex equipment such as transmission switches with multiple circuit packs and configurations the process is much more difficult.

The third database type is the Integrated Manufacturing Database (IMDB). This is the local database for each manufacturing site and it contains all the information that is used to track the product through manufacture. Other systems will also be used depending on the site and the product line to manage the order process for materials, parts and sub-assemblies and to mange the customer ordering and shipment processes.

For complex products requiring customer specific preferences and configurations a unique job description document may be produced detailing number, type and configuration of the equipment ordered by the customer. The super BoM that is drawn up for each product will then specify the codes and release numbers of each of the circuit packs or cards needed to complete the configuration.

When the product leaves the premises of Nortel Networks the sales information is recorded and, through the unique product code, any child codes (codes of sub-assemblies) should be identifiable in IMDB and IEDB. Once in the field (installed at the customer's premises) the equipment may be upgraded resulting in circuit packs being changed or added. Circuit packs may also be removed for repair or overhaul during standard maintenance procedures. If this does occur it is unlikely at this point in time that the information would be updated or recorded on any central database.

The BoM contains codes that refer to specific components. Each component engineering code relates to the functionality of the component and is not supplier-specific. Thus, when the product leaves Nortel Networks it is not known exactly which suppliers supplied the components within the product. Any particular component or commodity could have between one and fifteen potential suppliers that are qualified and listed on the partSMart database. With the introduction of the supplier reduction programme at Nortel Networks and optimisation of the supply chain the number of qualified suppliers per commodity is falling.

The situation is, therefore, complicated in terms of the potential collation and aggregation of component material data into distinct product material profiles. The most sensible approach would be to generate average component material content data based upon the material declarations from the individual suppliers specific to Nortel Networks. This would increase uncertainty in the data but would make the process more manageable and aligned to the current process.

Any capturing and databasing of material content data would require a radical change to the current information management practices in place. New fields would need to be added to partSMart and these would need to be able to be captured in the software used to generate BoMs from partSMart (WebCrop). The ideal scenario is that the component material data content are stored in partSMart, having been automatically transferred from the supplier's web site, and the data is aggregated automatically as the BoM for the sub-assembly is built and then for the super BoM.

The final result would be a material profile for the Nortel Networks product. This information could then be used as part of a Product Environmental Profile provided to customers and to answer customer requests for information. One of the more advanced ways of presenting product material content information to customers would be in the form of a virtual reality 3-dimensional image, which provides exploded views of the product indicating where the main hazardous and valuable materials are. Such an idea was briefly explored recently at Nortel Networks but it remains as yet undeveloped.

The process of collation of data is made even more complex now with the introduction of contract manufacturing at Nortel Networks and the possibility that contract manufacturers may be mandated to select their own suppliers for commercial off-the-shelf components. Contract manufacturers would be expected to provide material declarations themselves and the onus would be on them to collect the data and use an eco-evaluation methodology if necessary.

Three example products were selected to demonstrate the difficulties associated with the creation of material profiles. The first is an established and relatively simple product: the M7310 business telephone. The second is a new and innovative telephone using Internet technology: the iNCA i2004. The third is an established and complex switch cabinet containing thousands of components (Super Node).

7.2.2 M7310 Telephone

The M7310 business telephone is designed for users with extensive calling and call handling requirements. Its features include:

- LCD window with soft keys - walks users through features and applications. This makes the M7310 one of the easiest telephone systems to use, and eliminates the need for time-consuming and expensive training;
- High - quality built-in hand-free speakerphone;
- Intercom - increases the convenience of interoffice conversations, while keeping outside lines free;
- Programmable buttons – enables users to customise the phone with the right mix of features, lines, and intercoms;
- Memory buttons - provide fast access to frequently dialled numbers;
- Call log - tracks and records incoming calls;
- Hold - provides waiting callers with tones or music plus a periodic reminder of held calls;
- Volume control - lets the user adjust the ringer, speakerphone, headset, and handset volume;
- Automatic set relocation - ensures that each phone stays programmed through office moves;
- Selective ringing tones – provided users with the choice of four ringing tones to easily distinguish their phone's ring from others nearby;
- Headset jack - allows the convenience of a headset without unplugging the handset;
- Wall-mount capability; and
- Attractive, compact design - in colours of black, ash, or grey.

The functionality of the M7310 can be further improved with the addition of a busy lamp field. This feature enables the user to see the status of as many as 24 telephones. This is a necessity for receptionist and secretarial personnel who need to know whether a phone is idle, busy, or on "Do Not Disturb" before transferring a call.

It is clear that this type of business phone has considerably more functionality than a standard telephone set.

The M7310 was selected for this case study, as it is a well-established and reasonably sophisticated product using components and materials that are common in many electronic products. This type of phone was first introduced as a Nortel Networks product in 1993 and has undergone several releases and modifications since. The phone was originally manufactured in Calgary, Alberta, Canada and Cwmcarn, Wales UK. It is currently manufactured in Monterrey, Mexico.

Appendix XI provides detailed images and drawings of the phone to illustrate both the shape and size of the assembled unit and to show exactly what the components look like. Figure 34 shows the assembled phone set.

Appendix XII provides a full BoM of an M7310 with a unique product code and release number.

Figure 34. M7310 Telephone (Black)

The phone consists primarily of plastic ABS casing, a printed circuit board with two integrated circuit components plus other smaller components, a liquid crystal display assembly including screen and mylar flexible circuits, the speaker assembly and the button assemblies. The various components that constitute the phone are shown in Appendix XI. A breakdown assessment of the general material content of the phone is presented in Table 26.

Table 26. Typical Material Content of a Shredded Phone (Environment Canada, 2000)

Material	% Weight
ABS	44.0
Steel	8.9
Non-ABS plastics	23.0
Circuit boards	2.6
Copper	5.5
Waste	0.4
Box, wrapping and documentation	15.6
Total	100.0

Two previous LCA studies have been conducted on the M7310 phone set. The study carried out in collaboration with Environment Canada and Ecobalance Incorporated

(Environment Canada, 2000) aimed to "better understand the potential economic and environmental benefits of emerging environmental management concepts such as product life cycle management and design for environment". The various life cycle stages of the phone were modelled. The data used were primarily sourced from Ecobalance LCA and DFE software (components and materials) and suppliers (one integrated circuit, the mylar flexible circuit and the printed wiring board). The study generally used generic component, material and process data. The study concluded, not surprisingly, that the use phase of the phone set is the dominant phase for environmental impact using the selected impact indicators of greenhouse effect and air acidification. The component manufacturing stage had the greatest impact in terms of raw material depletion and water eutrophication. The application specific integrated circuits provided the largest contribution to the greenhouse effect for the manufacturing phase. Two design changes (new keypad technology and thin-walled housing) were proposed and modelled but they had little effect on the life cycle impact.

Obvious areas to focus on for improvement were energy consumption during the use phase and chemical and material use along with energy use in the component manufacturing stage. The study illustrated that LCA was limited without comprehensive, accurate and readily available data and that in the electronics industry it was perhaps best used as a prioritisation or guidance tool for ecodesign practices that can be used during product development.

The second LCA study was conducted by Ecobalance UK and focused on end-of-life environmental impact and costing scenarios in preparation for the proposed WEEE Directive (Ecobalance UK and DMG Consulting Ltd, 1999). Three scenarios were tested: 100% landfill, current UK end-of-life practices and end-of-life practices meeting the requirements of the WEEE Directive. The results for the M7310 phone are:

- Current (1999) UK processing and disposal routes result in less environmental impacts compared to 100% disposal to landfill;
- The measures required by the proposed WEEE Directive result in a decrease in environmental impact compared to current UK practices;

- None of the scenarios appear cost-effective. This is due to the inclusion of significant processing costs (refurbishment) for the current situation and also for the proposed WEEE Directive scenario.

A third study has also been conducted on the M7310 phone set as part of a PhD research project in Canada. The phone set is being used as a test vehicle for a computer tool for OEM decision support in asset recovery of electronic and telecommunication equipment. The case study of the M7310 has been supervised by the RE. The detailed results from the study are provided in Document C4.2 (Johnson, 2002). The conclusion drawn from this study was the M7310 was economic to remanufacture at the current time. This is supported by the success of the current Nortel Networks remanufacturing programme. However, the WEEE Directive will generate greater costs at end-of-life due to the volume of phones that will have to be recycled.

Nortel Networks has an established recovery and refurbishment programme in place both in Europe and North America for the Meridian and Norstar (the name Meridian was changed to Norstar) telephone ranges. Thousands of phones are economically refurbished and re-sold per year. Twenty thousand M7310s are recovered each year of which sixteen thousand are refurbished and re-sold. Those phones that are not refurbished are screened for any potential re-usable components that are removed the remainder are disassembled into two streams: ABS plastic (casings and buttons) and metals (predominantly the printed circuit board). The average proportion of each M7310 that is recycled, re-used (components) or landfilled is presented in Table 27.

Table 27. Fate of Disassembled M7310 (Source: Nortel Networks Asset Recovery)

	Percentage
Recycled	75
Re-used (components)	20
Landfilled	5

Each proportion for recycling is shredded and recycled directly or smelted. The estimated costs and values for end-of-life management of the M7310 are provided in Table 28 (from a UK recycling company). The figures would fluctuate with a change in volume or the value of scrap materials.

Table 28. Estimated Costs and Values for End-of-Life Management of the M7310 (source: UK Recycling Company)

Material or process	Weight (kg) or Time (s)	Cost (£)	Value (£)	Balance (£)
Disassembly time	4	0.55	-	-0.55
Light iron	0.088	-	0.005	0.005
Copper cable	0.090	-	0.015	0.015
PCB	0.040	0.80	0.84	0.04
Clean plastic	0.040	0.95	0.95	0
Contaminated plastic	0.560	0.01	-	-0.01
Manual and packaging	0.256	0	0	0
Total		2.31	1.81	-0.50

These figures have been generated by a recycling company and are based upon the company completing all the tasks. Because currently at Nortel Networks the majority of phones are refurbished and those that are recycled are disassembled in-house the costs of disassembly are not seen directly on a per unit basis. Much of the cost will be integrated into the overall economy of the product end-of-life management process. The figures quoted by the recycling company actually result in a cost for end-of-life management of 50 pence per unit.

At Nortel Networks at the present time all asset recovery processes are considered to be ad hoc. This means that any value or cost associated with end-of-life management of the product is not considered in any life cycle costing calculations that are made to generate a unit cost for the product and for the customer. Considerable revenue is generated from the refurbish and re-use programme and this revenue is returned to the line of business responsible for that product portfolio. The units that are disassembled for recycling are grouped together with other material from asset recovery operations for other products and generally at the moment this practice breaks even (taking into account recycling processing costs and costs for disposal of non-recyclable material).

The main stated reason for not including any end-of-life management costs or values in the life cycle cost of the product is that predicted costs and revenues for a product that has a predicted life-time of between five and fifteen years would be loaded with uncertainty. However it would be useful to have a strong idea of what proportion of the product would potentially generate revenue at end-of-life and which would result in a cost based upon current scrap values for the materials. This would require accurate product material content data from the supply chain and possibly the use of an evaluation tool such as that advocated by Middendorf et al (2000).

In terms of generating a material profile for customers the M7310 telephone would be relatively simple. Customers main concerns are hazardous materials and if the component data were available with only 150 components in the product it would be straightforward to generate a hazardous material profile. Access to component suppliers for the M7310 was not available so it was not possible to capture component and supplier-specific data. The data used in the LCA modelling study have been used to generate the profile in Table 29. These data are based on some supplier specific data and data from the Ecobilan DEAM database. It can be seen that ABS plastic and steel dominate the profile given the data set used. However, other substances are present in the phone but are not captured or specified in the output from DEAM.

Table 29. Material Composition of a Telephone (DTI, 1999)

Materials	Weight (kg)	%
Ferrous Metal		
Steel	0.14	10.7
Non Ferrous Metal		
Copper	0.03	2.3
Plastics		
ABS	0.77	58.8
PVC	0.07	5.34
Other plastic	0.07	5.34
Other materials		
Pb	0.11	8.4
Rubber	0.03	2.3
Glass (LCD)	0.03	2.3
Misc	0.06	4.52
Total	**1.31**	**100**

7.2.3 i2004 Internet Telephone

7.2.3.1 Overview

The i2004 Internet Telephone is the newest member of the Nortel Networks Succession Internet Telephony portfolio. As an Internet Protocol communications device, the i2004 connects directly to a customer's Local Area Network via a 10/100BaseT Ethernet connection and translates voice into data packets for transport over the data network. The i2004 is one of the next generation of business communications devices supported on multiple Nortel Networks service platforms became available to customers in 2001. Physically the i2004 looks very similar to currently available digital telephones from Nortel Networks (see Figure 35).

The i2004 offers the following features:

- Large multi-field LCD display, including six user-programmable keys for direct access to lines or voice features;
- Wideband–compatible speakerphone with acoustic echo cancellation;
- Integrated headset jack with on/off button;
- User-selectable ringer, speaker, handset, and headset volume;
- Special purpose service keys for access to commonly used applications and services;
- Integrated accessory and expansion bay connectors to support future service enhancements;
- Local generation of call alerting, call progress, and dial pad tones;
- Dedicated hold, release, hands-free and mute keys; and
- Hands-free speakerphone with LED.

Figure 35. i2004 Internet Telephone

Images of the product in disassembled form and a complete bill of materials including all qualified and potential suppliers of components and materials are provided in Appendices XIII and XIV. The phone contains approximately 200 individual parts including moulded ABS plastic casings and standard and customised electronic components. Unfortunately it was not possible to contact each supplier for detailed material declarations of components. One of the original aims of the research project was to have a standard procedure in place to capture data from the supply chain and the generation of material profiles could then be generated for selected products. However, the proposed data capture element of the research has not been implemented and therefore data are not readily available.

The information presented in Appendix XIV demonstrates the complexity surrounding component material content capture and collation even for a relatively simple product due to the range of suppliers that may be qualified for each component. If component material declarations were available from suppliers it would be necessary for those components with multiple suppliers to generate an average material content for use in any final product material profile.

Ecodesign Initiative

An ecodesign research study was conducted by a research group within Nortel Networks based in Canada as part of a second generation cost reduction design initiative for the product i.e. the first release of the product was complete. Areas of the physical design were selected for focus and proposals generated for changes to the design that would result in improved environmental performance. Ten design areas were initially selected but only four emerged with feasible suggestions for environmental improvement. This work was conducted by Hamra and Collins (1999) and selected details are provided in Appendix XV. It illustrates the need for important and often fundamental trade-offs to be made if ecodesign decision-making is to be integrated into the product development process. Maintaining physical integrity and reducing costs are not always compatible with ecodesign proposals.

It is anticipated that i2004 telephone sets would undergo the same process at end-o-life as the M7310 and the majority of Nortel Networks business telephone units (refurbishment and re-use or disassembly, shredding and recycling).

7.2.4 DMS Supernode SE

7.2.4.1 Overview

The Nortel Networks Digital Multiplex System (DMS) Supernode switch is a high-capacity switching system that provides voice, data and video transmissions. The DMS family consists of many different switch types configured to provide the specific requirements and functionality of different locations within the network. The DMS-100 system is a "switching centre that serves the local level in the public switching network and is operated by local exchange carriers. It is designed for end-office applications having a capacity of 1500 to more than 100 000 subscriber lines" (Nortel Networks 1999c).

The DMS-100 provides access to long-distance services and other networks, handles traffic from private branch exchanges and provides residential and business services ranging from basic telephone service to a full compliment of advanced voice and data services. The system is comprised of many nodes that are housed within standard ETSI cabinets. The Supernode SE is a compact version of the DMS-100 and fits into a single cabinet. The DMS SNSE reduces the network operator's cost of ownership with reduced footprint, power, spares, and engineering. As an office grows, the system's network capacity and revenue-generating potential can be extended with a transition to the standard supernode platform.

7.2.4.2 Functional Layers

The DMS-100 system can be grouped into three functional layers (Nortel Networks, 1999c):

Service Processing Layer

The nodes within the service processing layer process signals and provide central call handling and overall control of calls. This layer also provides control and management of all nodes in the switch.

Signal and Connectivity Layer

The nodes within the signal and connectivity layer permits internal communication among the parts of the switch. This layer carries and connects digital traffic such as customer voice/data. The nodes within this layer also allow technicians to input commands and receive output from the switch. The nodes may send messages to attached devices such as a Visual Display Unit (VDU) or a printer to alert the technicians of a problem.

Physical Access Layer

This layer allows lines and trunks to be connected to the switch. This layer originates and terminates calls (calls enter and leave the switch through this layer). Nodes within this layer also handle incoming signals, for example, they convert analogue signals from a customer into digital signals that the switch can use.

7.2.4.3 Major System Nodes in the SNSE

The major system nodes of the SNSE that support the functional layers are as follows:

Computing Module

The computing module mainly exists within the Service Processing Layer and is the central processing engine of the SNSE. It consists of the DMS-Core which provides computing and memory resources for overall system management and control; the System Load Module for mass storage with a disk drive, cartridge drive, and controller to store office images, load new software, back-up systems data and enable emergency system recovery; and the DMS Bus (or Message Switch) residing in the Signal and Connectivity Layer that handles message communication between the switch nodes.

Link Interface Shelf

This is a modular unit and a node within the Signal and Connectivity Layer. It provides limited local switching capabilities and allows the switch to interface with a variety of specialised network data formats. Its modularity allows the addition of different circuit packs as demand increases.

ENET Switch Matrix

The Enhanced Network (ENET) switch fabric provides many thousands of connections for calls to reach their destinations. It is also part of the Signal and Connectivity Layer and forms one shelf in the SNSE.

Peripheral Modules

Peripheral modules are physical layer nodes that provide the interface (analogue or digital) between the switch and the outside world. These modules are housed in their own cabinets and are not an integral part of the SNSE.

7.2.4.4 Physical Packaging

The DMS-100 SNSE hardware is housed within equipment cabinets. The hardware circuit packs are fitted into allocated equipment shelves. SNSE cabinets have the following dimensions:

Height	1829mm
Width	1067mm
Depth	725mm
Weight	730kg (although depends on configuration).

The major system nodes and the cabinet layout are shown in Figures 36 and 37.

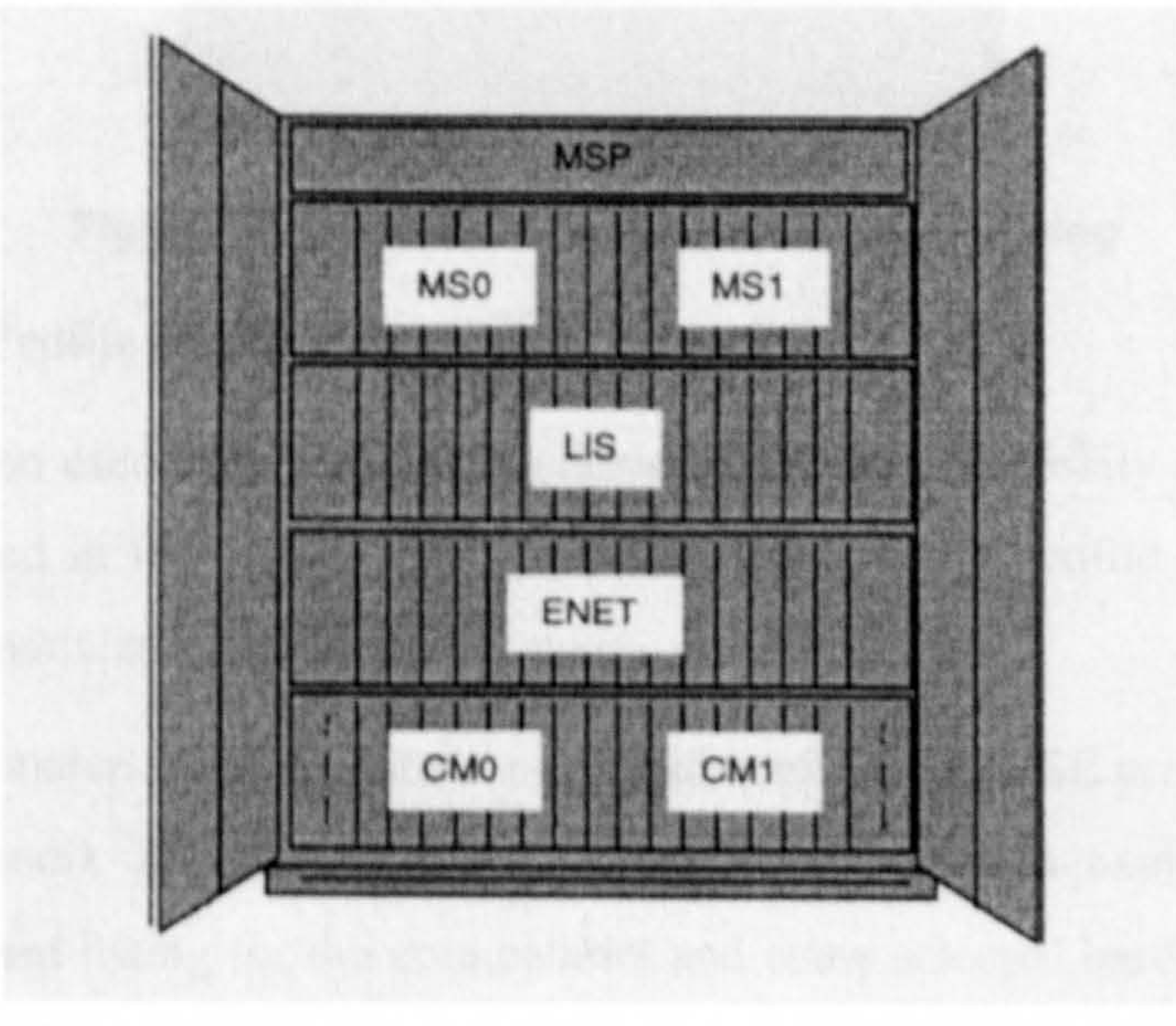


Figure 36. SNSE Hardware Layout

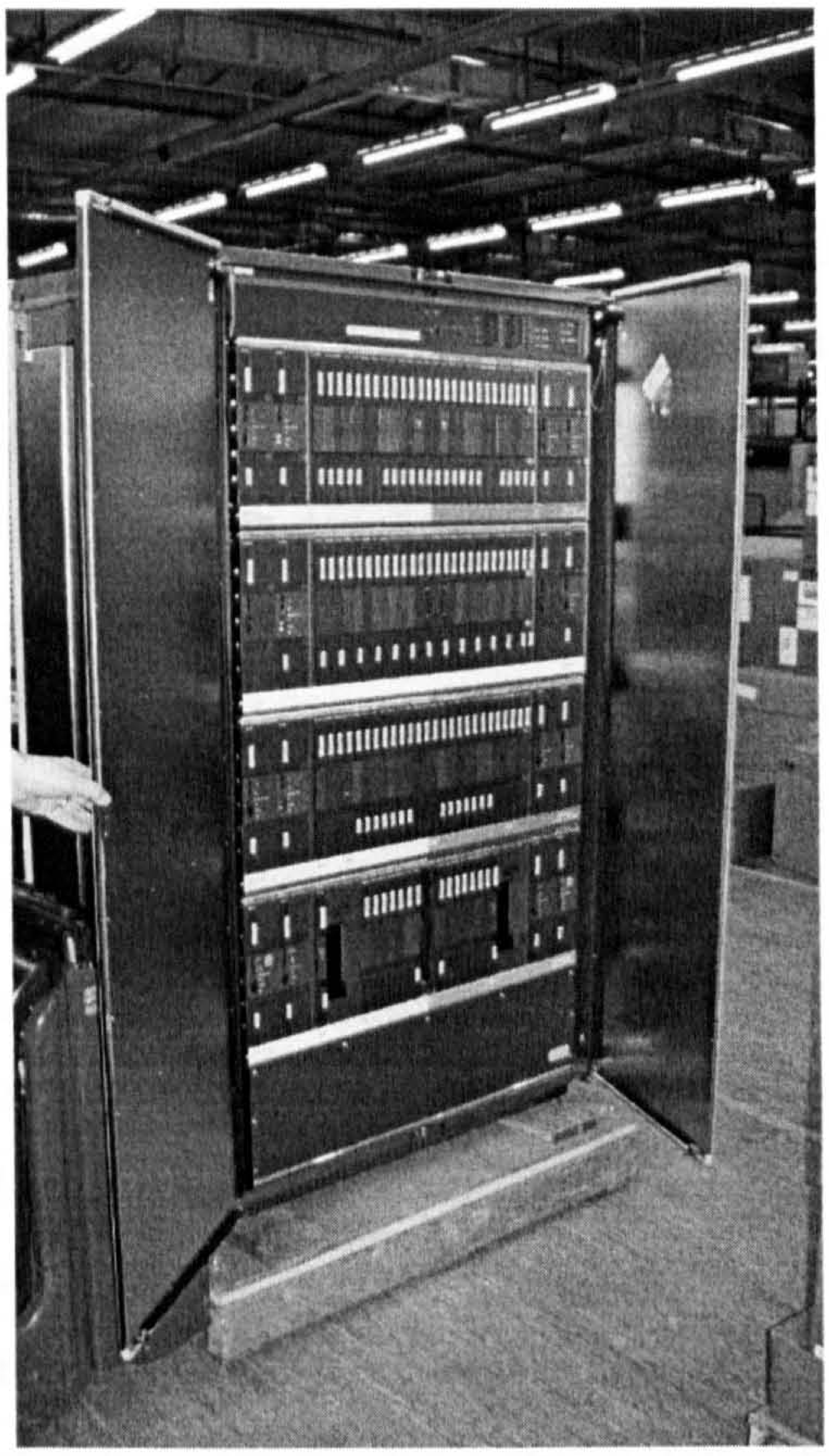


Figure 37. Custom Configured SNSE for Shipping

7.2.4.5 Material Profile Data Management

The SNSE has been used as an example to demonstrate the complexity and the quantity of data to be managed in the generation of any detailed material profile for a switching or complex telecommunications product.

A compete bill of materials for a customer-specific configured SNSE product (Figure 37) is provided in Appendix XVI. The top-level super BoM has been exploded to provide a complete component listing for the core cabinet and some selected hardware circuit packs. Three circuit packs have also been selected to demonstrate the potential range of suppliers that are qualified to supply a specific item. The full list of suppliers of each component could only be obtained by manually entering the product code into the search function of the component database or the supply management database. There is currently no means of generating automatically a full list of component suppliers from the BoM for a product.

Images of the SNSE and individual circuit packs that can be cross-referenced with the BoM are provided in Appendix XVII.

If material declarations from component suppliers were captured and average profiles generated per coded item, it should be possible to generate a collated profile per sub-assembly code and subsequently a profile for the top level Nortel Networks product code. The resource intensive element of this process would be entering the component material data into the component database. The data management systems already in place could be adapted to manage the data from the component database through the generation of child-level BoMs and the super BoM. The final profile could be captured and held on the Nortel Networks central product database IEDB.

In practice this would require a commitment from Nortel Networks to establish a programme to capture data (possibly collaborative), start manually adding material data to a field in the component database (currently partSMart) as part of the component coding process and modify the software for generating and storing BoMs for products. At this stage the company is participating in a European electronics industry group collaborative programme to establish a common process for material data capture from the supply chain but no formal commitment to the establishment of a product material profile system has been made.

7.2.4.6 Material Profile

A study was conducted by a research group in Canada to investigate the compliance of the DMS-100 family of products to the proposed 3rd Draft of the WEEE Directive (Nortel Networks, 1999d, EC, 1999). Part of this study included the attempted capture of component material data from the supply chain for selected components using the data capture template as described in Chapter 6. WEEE Draft 3 contained proposed material bans that are now specified in the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Directive (EC, 2000). Thus, an assessment of compliance to the 3rd Draft of WEEE required hazardous material declarations for the components.

Components from common hardware units for a variety of DMS equipment including the SNSE were selected and suppliers contacted for information. Detailed results from the study are provided in Appendix XVIII. The results were not encouraging with few suppliers being able to readily provide the required data. This supports the results of the sample data capture exercise detailed in Chapter 6.

The conclusions to be drawn from all efforts to generate material content data on a per product basis within Nortel Networks are that suppliers are not currently in a position to provide detailed material content data although the requests made have only been for isolated specific projects or technology research projects.

Until component material declarations become a standard element of component qualification and data requests it will continue to be very difficult to generate accurate product material profiles of products. Currently systems are not in place to capture appropriate data and efforts to do so have either been prevented or had very limited success.

7.3 Legislative Requirements

The implementation of Level 1 eco-evaluations (as detailed in section 7.1) would result in the meeting of legislative requirements concerning material bans or restrictions. This assumes that a list of appropriate material regulations are maintained by organisations such as Nortel Networks and are referenced in any component qualification. Each component supplier would be expected to declare the presence of any specified materials in each product using a product material declaration form. Such negative material declarations are the easiest and preferred method of material declarations for suppliers and it should be a relatively simple process to implement the Level 1eco-evaluation methodology described in Chapter 6.

7.4 ISO 14001 Continual Improvement

In Chapter 5 it was stated that the supply chain is considered to contribute indirectly to the environmental aspects and impacts of Nortel Networks and any telecommunications company. Therefore, any methodology designed to quantify or evaluate the environmental performance of suppliers could theoretically be used as a tool to gauge continual improvement.

The eco-evaluation methodology proposed in section 7.1 is designed to quantify the eco-performance of each component from each supplier using selected criteria. This allows a benchmark to be determined that can serve as a basis for improvement.

In addition, the format of the SEAP questionnaire allows for the submission of information on supplier initiatives designed to improve environmental performance. This type of non-quantitative information, if interpreted correctly, can also provide a basis for evaluating continual improvement.

The current approach to supply chain management by Nortel Networks and many electronics companies emphasises the importance of partnership rather than competitive selection. This approach involves the development of an agreement between the customer and the supplier that results in benefits to both companies and a close understanding and working relationship. The customer gains security of supply, early access to new technology developments and preferential purchasing rates. The supplier gains market security and access and awareness of future market and technology developments (roadmapping). The outcome should ultimately provide a more effective solution to the final customer (in Nortel Networks case the telecommunications service providers such as British Telecom).

In terms of continual environmental performance improvement for products, the partnership approach enables innovative input on product development ideas from both parties. The supplier may have a "greener" product that it wishes to launch into the market which it can trial with a preferred customer. Likewise a customer can work with a supplier on improving the environmental performance of the product through collaborative discussion and research. Even if the situation arises whereby the environmental performance of a supplier's product is considered below that of competitors (but meets legal requirements), because of the business relationship, a solution or compromise will be found. This could lead to the customer being committed to a supplier with products having inferior environmental performance than other suppliers in the market. Of course many factors are considered in the awarding of preferred status to suppliers and generally environmental issues are typically considered of less importance. Legal compliance or some form of minimum requirement is standard. Some organisations may adopt a more extreme approach and set stringent minimum requirements to be met or the supplier faces de-selection (e.g. B&Q).

The alternative to the partnership approach is one of hard competitive supplier selection that involves frequent assessment and appraisal of suppliers on a per contract basis without long-term commitment. This allows the customer greater flexibility. This scenario could result in overall improvement of the environmental performance of components as suppliers seek to differentiate their products more frequently than when bidding to become a partnership supplier.

At the present time it is suggested that environmental performance is not a differentiator in supplier selection unless all other things are equal (which they rarely are). No preference would be given to a supplier who could offer components with superior environmental performance unless there were clear additional benefits to the customer such as reduced life cycle cost. One Nortel Networks supplier that had been proactive and developed a potentially "greener" alternative product was keen to explore opportunities for preferred selection on the basis of the product's green credentials (the product met all technical and quality requirements).

Many electronic component material innovations and initiatives that could result in a demonstration of continual improvement through material substitutions and improved eco-evaluation scores are often instigated by industry collaborative groups. Rarely does one company invest heavily in a materials development programme in isolation. Also many electronics industry groups or trade associations now have national and international roadmaps that detail the technological challenges and needs of each industry including environmental, health and safety. Examples of such roadmaps include the International Technology Roadmap for Semiconductors coordinated by Sematech, the National Electronics Manufacturing Initiative technology roadmap, and the Institute for Interconnecting and Packaging Electronic Circuits National Technology Roadmap for Electronic Interconnections. Many of these roadmaps specify environmental technology issues relevant to the respective industry. Several industry groups have organised work programmes to investigate the issues considered to be of particular importance. Those of note include efforts by NEMI and the High Density Packaging User Group on lead-free solders and non-brominated flame retardants. These are mainly driven by the potential phasing-out of these materials through the introduction of the RoHS Directive in Europe and proactive introduction of lead-free solders into products in Japanese electronics companies.

Programmes and guidelines are also devised for more "everyday" environmental issues at an industry group level. These may include the development of "cleaner" process techniques or energy consumption reduction initiatives. Several suppliers indicated that they used and adhered to industry group roadmaps and guidelines on environmental best practice for the industry sector and that these actions formed the basis of any product focused continual improvement efforts.

Driving continual improvement in product environmental performance in the supply chain is a complex task. The provision of component material data to customers could provide a basis for an eco-evaluation and a benchmark for further measurement. For really significant improvement to be made though, a strong commitment to product environmental issues by both the customer and supplier are essential. In the current financial climate in the telecommunications and information technology sector eco-innovation and investment in environmental initiatives may not be a priority unless they are required to meet the needs of legislation.

7.5 Conclusions

This chapter has been concerned with how supplier component material data and company environmental performance data could be used by Nortel Networks or any electronics company.

A methodology for the eco-evaluation of components from specific suppliers has been presented and discussed. The methodology is hierarchical and flexible depending on data availability and the required depth of evaluation. It can be used as part of the component qualification and supplier selection processes. The objective is to provide an environmental performance element to component and supplier selection decision-making.

The feasibility of generating telecommunications product material profiles from component supplier data is assessed. Product material profiles would provide customers with the information that is commonly requested and would also provide companies such as Nortel Networks with detailed information regarding the propensity of the product to be re-used or recycled. Theoretically the collation of component material declarations with reference to a product bill of materials can be achieved. However, the volume of data would be huge for complex telecommunications products that may contain tens of thousands of components.

The hierarchical eco-evaluation methodology would provide a means of checking compliance to relevant product-focused legislation and of measuring component environmental continual improvement.

Chapter 8 Discussion

The objectives of this chapter are to discuss:

- The results of the research project; and
- How the key findings provide a contribution to the application of Product Life Cycle Management.

In this chapter the results of the research project are expanded upon and analysed in more depth with emphasis on the practical application of recommendations and the contribution to knowledge in the field.

The focus of the project is the provision of mechanisms for more informed decision-making in the process of PLCM. This has resulted in the examination of methods to capture component-level data for complex telecommunications equipment and to use these data in key phases of product development and production thus resulting in improved product environmental performance over the life cycle of the product.

Perhaps the most important research findings relate to the need for mechanisms for component level data capture from the supply chain if:

a) Telecommunications products are to comply with product legislation;

b) Customer requirements are to be met; and

c) Products are to improve in terms of their environmental performance.

With the availability of accurate and reliable data on electronics components more advanced supplier evaluation and selection processes such as the eco-evaluation hierarchy developed in this research can be conducted as a component of a business strategy to commit to continual improvement and ultimately sustainability.

When the research programme was initially scoped it was envisaged that a data collection programme could be implemented within Nortel Networks as a first step, followed by the creation of aggregated product material profile generation and advanced supplier selection processes. However, because the organisation was unable to commit to a programme of data collection as a formal element of the supply chain management strategy, the data collection element remained a research and development initiative within Nortel Networks. The reason for not being able to commit, it would appear, was the organisation still perceived the capturing of detailed data on components from suppliers to be unnecessary at that time. The decision was, and still is, highly contentious because of the potential enormous cost and burden placed on the supplier.

This scenario greatly limited the volume of data that could be collected and severely limited the possibility of testing the creation of complete product material profiles for Nortel Networks products. The results of the first phase of the research, however, highlighted the fact that suppliers of electronics components were not, and still are not, in a position to be able to readily supply the required data.

An additional limitation to the research was caused by Nortel Networks not approving a detailed exploration of why customers requested such detailed information on the environmental performance of products and how the information was used in the customers' supplier selection processes. This was particularly disappointing because it would have revealed some interesting details.

The issues outlined above highlight the complications involved when conducting research in an industrial and commercial context. However, the value gained from conducting research in industry far outweighs the limitations.

Because of the data capture issues the research shifted focus on how the data could be used, particularly in terms of supplier selection, assuming it could be captured.

It is concluded that supplier product and company environmental data can be integrated into the ecodesign and Product Life Cycle Management systems of Nortel Networks or any telecommunications network solutions company. However, at the present time, because of the limited volume of accurate data available on the material content of electronics components, the implementation of a data capture and product material profile system may not be immediately feasible. As the time draws closer for legislation such as the RoHS and WEEE Directives to be implemented, greater urgency may be placed on implementing such a system. It is suggested that an industry collaborative programme may provide the best solution.

Because the research was based within one organisation, Nortel Networks, it could be argued that any results and recommendations could only be valid for this specific organisation. However, the methods for data capture and component environmental selection can be used in any organisation that has a multiple sourcing supply chain strategy, a need for a system to capture and database supplier and component-level information and an objective of improving product environmental performance through informed supplier selection decision-making. The majority of telecommunications equipment and network providers use similar approaches to product development, supplier sourcing and manufacturing methods. The results of this research are, therefore, applicable to all.

The concept of using supplier-specific component-specific material data for supplier selection, meeting the requirements of legislation, improving product design and the creation of product material profiles is a simple one. However, the practice of turning this concept into a reality is not so simple. This research has explored options for making the concept a reality and has yielded a unique set of results and recommendations.

The first phase of the project focused on the determination of what type of data needed to be captured from the supply chain to meet certain, specified requirements. The outcome was clearly, as close to one hundred percent materials composition of components supplied as feasibly possible. In addition, comprehensive data on supplier environmental management processes were also required.

Web-SEAP was created as a means of capturing the required data. A discussion of the design of web-SEAP was provided in Chapter 6. The ultimate goal for product/component material declarations from suppliers is material content by mass. A range of options for data format is available which could all reach this goal, including percentage material declarations combined with total mass and actual materials mass declarations. Additional complexity with materials declarations is often caused by inconsistency in terminology. Materials, substances, compounds, chemicals and chemical elements are terms that are often used and interchanged. Clear and consistent terminology or classification is required.

The recommendation is that a collaborative industry-wide solution is developed to provide a consistent and standardised method for product material declarations on a global scale. However, the decision-making process to achieve such an agreement is protracted, fraught with argument and counter argument, and ultimately perhaps, untenable. It is extremely difficult to attain agreement not least because the representatives at each meeting do not have decision-making power within their organisation and cannot commit. They have to feedback information to their board and this generates cycles of iteration. In addition, every organisation has their own way of conducting business and their own perceived priorities and sense of importance.

Efforts are currently ongoing to reach an agreement between EICTA, EIA and a Japanese electronics industry association. Meanwhile, some companies are now eager to implement systems in isolation as a perceived urgency now manifests itself with the WEEE and RoHS Directives looming on the horizon. Nortel Networks, at this time, are not committed to any programme for materials declarations.

In addition to the problems that exist regarding a global data capture system perhaps one of the more fundamental issues that needs addressing for each participating company is the use of the data that are captured, particularly for the generation of product material profiles.

There are two main approaches to the aggregation of component material composition data to a product material profile. One is to manage the material data in a system completely separate from any existing component data management system in place in the organisation. This means bill of materials information for products has to be imported into the product composition system to enable aggregation to take place. This may be the optimal solution for organisations that use multiple product data management systems across different lines of business.

The second approach is to integrate the component material composition data into existing component data management systems. This involves migrating data from fields in the materials declaration capture system to fields in the existing component data management system. The bill of materials for products will be generated in the standard way and queries can be run using the existing system. Because Nortel Networks use standard component and product data management systems throughout the organisation this would be the recommended approach. WebCROP (described in Chapter 7) or similar software, could be used to generate the product material composition.

One additional complexity exists, however, because the supplier of components that form a given product varies over time and per batch of products, any accurate product material profile generator would need to identify the suppliers of components for a particular final product and use the appropriate data. The current product data management system at Nortel Networks does not currently track the specific suppliers of components that form a product. Alternatively, average and/or "best or worst" case scenarios could be used.

A further requirement for any component material content data capture and product material profile system is the availability of trusted data of an acceptable quality. The research has shown that the availability of data is generally poor and that which is available has been generated using a range of methods. There is a need for organisations such as Nortel Networks (or a collaborative programme) to make the provision of data mandatory and for validation checks to be made to check for quality, consistency and method of capture, as these greatly impact the accuracy and comparability of the data. Until this happens the provision of data will remain varied and will primarily be from a group of proactive suppliers.

Finally, the data capture system needs to be technically "state-of-the-art". It cannot be future proof but it can be consistent with current and planned systems technology. As the electronics industry and commercial organisations in general move towards Internet and intranet-enabled applications and data management systems, it is imperative that any materials declaration data capture and supplier environmental performance data management systems are also internet-enabled. The recommendation is therefore, for an online intranet system.

As well as creating product material profiles the objective of capturing component material composition data and supplier environmental management information is to provide more information on which to base decision-making for supplier selection.

Component and mechanical part "eco-selection" assumes that eco-performance can provide differentiation between components with the same functionality, from different suppliers. That is, in addition to factors such as cost, reliability and supplier company performance issues. The contribution that the eco-performance of the component will have on the decision to select it will depend on the individual company's degree of commitment to ecodesign or improving environmental performance. Eco-performance has to compete particularly with quality, reliability, technology and cost. The consideration of full life cycle cost is becoming increasingly important. Components with less hazardous materials and improved recyclability or re-use potential could have cost benefits at end-of-first-life. These benefits could offset any "up-front" higher purchase costs for components with improved environmental performance.

Three core groups of decision-makers for component selection can be identified:

- Designers;
- Component Engineering Qualification Groups; and
- Manufacturing supply management groups (purchasers).

Discussions with design groups within Nortel Networks have revealed that because of the time to market pressures regarding new product introduction, designers would prefer that any form of component eco-evaluation be made before components are made available for use in design. Hardware (electrical) designers focus primarily on functionality. Components are selected from a database of components that have been pre-approved from preferred suppliers according to a range of criteria by the component engineering group. Components not available in the database are recommended by the designer and are subsequently subjected to the approval process. Designers do not have the time to evaluate the eco-performance of components and to consider possible alternatives.

The component engineering qualification group does have an opportunity to consider the eco-performance of components during the qualification process, particularly for new technologies, and to capture "eco-evaluations" and document them by posting the evaluations as a feature of the component attribute dataset in the component database. Currently the component engineering group within Nortel Networks uses supplier environmental assessment information obtained through the supply management function to screen a supplier's environmental performance. This research has yielded methods that go beyond simple compliance declarations and on to a comprehensive supply chain materials management approach.

Manufacturing supply management groups also have an opportunity to make component "eco-selections" in the selection of components to complete a bill of materials for a production run. Components are multi-sourced from different approved suppliers. It is suggested that it is possible to differentiate between suppliers of components on an environmental performance level (company and product) as most preferred suppliers would meet minimum requirements on quality, delivery, service, cost, business risk, and technology.

A four level hierarchy evaluation methodology is proposed as an innovative method for incorporating supplier environmental performance in supplier selection decision-making. This method can be applied by both component/supplier qualifiers and supply management groups. Toxicity and resource depletion were selected as being priority indicators of environmental performance using material composition data.

Level 1 eco-evaluations focus on hazardous material compliance. This involves a simple declaration from the supplier of what is not present in the component. This type of declaration is dependent on the evaluating organisation specifying a list of substances that must not be present in the component. The list consists of those substances that are generally banned by legislation, that are targeted for banning and/or are specified by customers for elimination. Hazardous material compliance is a common approach used throughout the electronics industry.

Level 2 eco-evaluations focus on the intrinsic hazardous nature of the materials within a component. Human toxicity and ecotoxicity potentials are combined with the material masses contained in the component. A comprehensive discussion of the reasoning and uncertainties associated with Level 2 toxicity evaluations is provided in Chapter 7.

Level 3 eco-evaluations consider both toxicity potential and resource depletion. The potential for recycling of certain materials is also considered when calculating the resource depletion score. The Level 3 eco-evaluation is finally calculated using multi-criteria decision-making techniques that consider both criteria.

Level 4 eco-evaluations consider toxicity potential, resource depletion and also the supplier's commitment to product environmental performance improvement through the quantitative score generated from completion of a questionnaire. Again, multi-criteria decision-making is used to arrive at a final evaluation.

In terms of simplicity and feasibility in electronics component eco-selection, a declaration of what is definitely not in a component is preferable (Level 1 eco-evaluation). This should ensure regulatory compliance as long as the appropriate lists of banned or restricted materials is maintained. However, to support advanced product life cycle management decision-making, particularly in terms of component or product eco-performance and life cycle costing, a more comprehensive eco-evaluation is required such as those proposed in methods 2 through 4.

The eco-evaluation hierarchy is designed to be flexible in its application. Organisations can choose which level to use. The higher the level of eco-evaluation used the greater the integrity of the supplier selection process.

The objective of the application of comprehensive supplier eco-evaluation is to initiate and influence the drive towards product environmental performance improvement throughout the supply chain. This can be actualised through benchmarking and communication to preferred suppliers and encouragement to improve. It can also be actualised through competitive selection. How it is used will depend on the supply chain management strategy adopted by the organisation and also the commodities (components and products) being evaluated.

The type of supplier eco-evaluation that an organisation chooses to implement directly influences the type of data that needs to be captured from the supply chain. This is also true for the generation of product environmental profiles and continual improvement initiatives.

Negative hazardous material declarations for components from suppliers only enable organisations to generate negative materials declarations for products and limit the opportunity for continual improvement initiatives. The more comprehensive the data captured from suppliers the greater the scope for organisations to produce detailed product environmental profiles and effect improvement.

A further step would be to incorporate production environmental burden data or life cycle analysis data into the eco-evaluation process. This is an important consideration but the probability of obtaining detailed production process environmental burden data for each supplier is low. Suppliers generally consider such data as commercially sensitive, particularly yield data. This is despite the fact that many component suppliers suggest that component production technology is common across the industry. Variations in production techniques are likely to exist but identifying them is particularly difficult. Numerous LCA studies in the literature have cited problems with data capture.

Another advancement for supplier and product evaluation would be to widen the scope to include social issues as well as environmental in a move towards sustainability performance evaluation. This would require a more comprehensive supplier evaluation questionnaire that would consider a supplier's sustainability management and product development initiatives.

One aim of conducting component and supplier evaluations is too identify components from specific suppliers with the current "best" environmental performance and to identify what improvement initiatives the supplier has planned. The proactive organisation committed to achieving sustainability will also consider options for sustainable product and service design and drive innovation throughout the supply chain. Technology and materials innovation may be the key to achieving sustainability in products and services. It is clear that dematerialisation and the reduction in hazardous substance use are fundamental first steps.

The structure of supply chains in the electronics industry has changed radically in the last five years from predominantly in-house design and manufacture to increasing volumes of out-sourced manufacture and component sourcing. This change may not only result in the majority of electronics products being manufactured by a small number of multinational electronics module manufacturers but also the majority of the components being sourced from a small number of global suppliers because of economies of scale. With this model, innovations in product environmental and sustainable performance will be reliant on end-to-end technology road mapping within an integrated production system. This could potentially stifle innovation as fewer organisations will be participating in the market.

However, the formation of very strong relationships between organisations in the supply chain could still result in environmental product improvements as solutions are developed effectively through collaboration and partnership. It is suggested that building partnerships, sharing information and ideas and focussing on continual performance improvement in all areas will yield the best results.

Within this discussion it is important to consider both the timing of the research and it's value to the academic and business community.

As the research programme progressed over the four-year period there were significant developments in the legislative arena, particularly with the ongoing refinements of the WEEE and RoHS Directives in Europe. In addition, the interest in environmental supply chain management initiatives within both the academic community (product environmental management) and the electronics industry has grown considerably in the last four years. Several companies and Universities have conducted research in this area (see Chapter 4). In terms of timing, the research has been conducted at a prime time in terms of the results and findings being of interest and making a contribution to decisions on environmental initiatives to be implemented by organisations.

The work conducted in the research project is considered to be innovative. It was conducted in an extremely dynamic environment and industry sector in a field that is increasingly becoming more significant and influential on the manner in which organisations conduct business. The research has revealed significant issues in the industry regarding supplier and customer relationships and the need for improved communication and sharing of information. The work has resulted in a method for eco-evaluation of components for improved decision-making in terms of component selection and ongoing continual environmental performance improvement for Nortel Networks and suppliers. The timing of innovative work is crucial if the findings are to be of practical use. It has been concluded that the recommendations from this research cannot be implemented immediately because it is evident that the electronics industry is not is a position to capture or provide the required product data. Thus, the timing of the work could be considered to be optimal.

The electronics industry is dynamic and in a state of flux given the impending environmental legislation from the EU. Over the next four to six years, organisations in the industry will be looking to manage the environmental impacts associated with telecommunications products. They will need to work closely with, or encourage, component suppliers to improve product environmental performances and in particular focus on researching new technologies for materials substitution.

In terms of contribution to knowledge the claims from the research are secure. This is strengthened by the current interest in environmental supply chain management in the academic community and even more so within the telecommunications industry. The field of ecodesign has evolved rapidly over the four years of the research and the number of studies and publications has continued to increase, reflecting the growing interest in the subject and the application of ecodesign methodologies and thinking. This research contributes to this ever-growing knowledge base.

Over the coming years it is conceivable that the findings and recommendations from this research project will be implemented by organisations in the telecommunications industry. It is likely that a collaborative industry group component materials declaration scheme will materialise eventually and environmental and social performance considerations will play an increasingly significant part in the supplier selection process.

Chapter 9 Conclusions and Further Work

The objectives of this chapter are to:

- Summarise the research project;
- State the research findings and contributions to knowledge; and
- Provide recommendations for further research.

9.1 Introduction

The research undertaken in this Doctorate project focused on product data capture and product material profile systems and methodologies for advancing environmental supply chain management for product life cycle management decision-making.

Key findings show that it is possible to integrate supplier product and company environmental data into the ecodesign and Product Life Cycle Management systems of Nortel Networks. A methodology has been developed for supplier selection using component material content data and supplier environmental management performance. A component material composition data capture system has been developed and tested. To meet the requirements of legislation, the requirements of customers of telecommunications equipment manufacturers and ISO 14001 continual improvement through ecodesign practices necessitates the capture of component-specific supplier-specific data.

It is recommended that an internet-enabled component data capture system is implemented along with a system for aggregating product material composition to enable the production of product material profiles. The component eco-evaluation methodology should be integrated into the supplier selection process. If these recommendations are implemented the organisation would be in a position to meet the requirements of product legislation and customer requests for product information and foster the continual improvement of the environmental performance of products.

9.2 Hypothesis Testing

9.2.1 Hypothesis

Supplier product and company environmental data can be integrated into the Ecodesign and Product Life Cycle Management systems of Nortel Networks or any telecommunications network solutions company.

Through the answering of the three research questions that each relate to a programme of work in the research project the research hypothesis has been proved.

9.2.1.1 Research Question 1

What information needs to be obtained from suppliers to meet the requirements of ecodesign, legislation, customer requests and ISO 14001?

It has been shown that there are four areas within a product life cycle management approach for telecommunications equipment that have requirements for, or would benefit from, a range of product material or environmental data from the supply chain.

Customers are increasingly requesting hazardous material declarations and even complete material profiles of products. Both the volume and detail of requests for information are increasing. Only by capturing detailed product material composition data from suppliers can accurate and comprehensive product material profiles be generated for the customers of Nortel Networks.

The consideration of component and material eco-performance during product development or ecodesign requires accurate information on component material composition and the availability of life cycle inventory data could result in even more informed decisions. Detailed product material composition data from suppliers can be used in component selection and in environmental performance evaluations of designs.

To ensure continued compliance with existing, pending and new legislation, particularly on material bans, for electronic products requires knowledge of the hazardous materials present in the components and materials procured.

The provision of product material data and a commitment to substituting hazardous materials and improving product eco-performance by suppliers are regarded as factors that could be integrated into a continual improvement cycle for ISO 14001.

9.2.1.2 Research Question 2

What methods can be used to obtain the information from suppliers?

Programme 2 of the research project was designed to identify how product environmental performance data could be captured from the supply chain. The research has resulted in a process for assessing the environmental performance of electronics components suppliers and a template for providing product materials data.

The preferred means of data transfer is online via the Internet. A web-based tool for supplier environmental assessment and product data capture has been developed in this work. It is feasible for the system for data collection to be integrated with current Nortel Networks component databases although further modification of existing systems would be required.

Methods for product material data validation have been investigated but further work is required in this area.

Perhaps the most manageable and cost-effective solution for product material data capture from the supply chain is an industry collaborative approach. Three such approaches are currently undergoing development and the research detailed in this thesis has contributed to the EICTA supply chain management materials declaration template.

9.2.1.3 Research Question 3

How can the supplier information be used by the Nortel Networks design community, purchasing function, ISO 14001 systems and sales functions?

A methodology for the eco-evaluation of components from specific suppliers has been presented and discussed. The methodology is hierarchical and flexible depending on data availability and the required depth of evaluation. It can be used as part of the component qualification and supplier selection processes. The objective is to provide an environmental performance element to component and supplier selection decision-making.

The feasibility of generating telecommunications product material profiles from component supplier data is assessed. Product material profiles would provide customers with the information that is commonly requested and would also provide companies such as Nortel Networks with detailed information regarding the propensity of the product to be re-used or recycled. Theoretically the collation of component material declarations with reference to a product bill of materials can be achieved. However, the volume of data would be huge for complex telecommunications products that may contain tens of thousands of components. It may not be feasible to generate detailed material profiles for telecommunications equipment at this point in time.

The hierarchical eco-evaluation methodology would provide a means of checking compliance to relevant product-focused legislation and of measuring component environmental continual improvement.

Fundamental to any of the uses of product material composition data is the provision of these data by suppliers. It is evident that at the present time suppliers are not in a position to be able to provide such data for a wide range of components. In addition, no evidence exists that any telecommunications equipment manufacturers are currently capturing complete material composition data for all components supplied.

9.3 MSc and PhD Conclusions

9.3.1 MSc Research on Validation Techniques for Material Composition

The validation of material composition data provided by suppliers and the development of standardised measurement techniques for components suppliers to use are considered important elements of any product material declaration system. An MSc research project was designed by the research engineer to investigate the various analytical techniques available.

The conclusions of the research were:

"Validation of quantitative data can only accurately be carried out if the exact method of initial analysis is known and replicable. Different methods of analysis will yield different results due to the techniques used, the different sensitivities that each method may have and the interference associated with each technique" (Widdowson, 2000).

Taking into consideration the difficulties associated with the development of a quantitative method the methods recommended are:

- Particle size reduction by grinding to ensure an homogenous powder;

- Scanning Electron Microscope/Energy Dispersive X-ray for initial analysis to determine the material composition and for the semi-quantitative analysis of bromine;
- Use of a combination of plasma techniques (Inductively Coupled Plasma /Sector Mass Spectrometry, Inductively Coupled Plasma/Atomic Emission Spectroscopy) to determine quantitatively the elemental composition.
- Pre-treat the sample by acid/caustic leaching to enable organic compounds to then be determined by either High Performance Liquid Chromotography/Mass Spectrometry or Gas Chromotography/Mass Spectrometry.

Further research in this area is required and suggestions provided in section 9.4.

9.3.2 PhD Research on the Economic Feasibility of Remanufacturing

An electronics remanufacturing (refurbishment) methodology developed in a PhD research project conducted in collaboration with Nortel Networks and this research project yielded some interesting results.

Conclusions from an analysis of the Nortel Networks M7310 business telephone suggest that it is economically feasible to remanufacture this type of telephone as opposed to demanufacture and recycling. These conclusions support the decision by Nortel Networks to remanufacture this product.

The remanufacturing methodology could be applied to more complex products but would be dependant on the provision of product material composition data from the supply chain as advocated in this research.

9.4 Contributions to Knowledge

The research conducted for this Doctorate has contributed to knowledge in the field of Product Life Cycle Management, and particularly Environmental Supply Chain Management.

Key contributions include:

- Identifying the data that need to be captured from suppliers to meet the requirements of legislation, customer requests for information, ecodesign of telecommunications products, and ISO 14001 continual improvement of product environmental management;

- The development and testing of a method to capture both management performance and product material data from the supply chain;
- The creation of a tool to evaluate the environmental performance of production related suppliers in the telecommunications industry; and
- The development of an environmental performance evaluation method for commodity qualification and purchasing decision-making.

Each of these contribution advance the field of Product Life Cycle Management and provide the telecommunications industry with knowledge and tools that can be used to improve environmental performance.

9.5 Further Work

9.5.1 Customer Information Requirements

One of the findings from the research conducted to answer the first research question on the information needed to be captured from suppliers to meet customer information requests is that detailed product material composition data are required to meet all customer needs.

However, it still remains questionable how the information is used by customers, particularly in terms of decision-making in vendor selection. This area was to be addressed in programme one of the research and a customer questionnaire was designed to obtain appropriate information. Unfortunately, the research could not be implemented due to strategic decisions restricting access to customers within the sponsoring company.

It is suggested that further research to investigate how information collected in the telecommunications industry "request-for-quotation" process is actually used would provide a valuable contribution to knowledge in the field of PLCM and supply chain environmental management. Of particular interest would be the extent to which supplier and product environmental performance play a part in the vendor selection process at the present time and whether they and/or Corporate Social Responsibility are anticipated to play a greater role in the future. The research would have to be conducted independently to ensure a broad range of companies is included in the study.

9.5.2 Social or Sustainability Considerations in Supplier Assessment

The research conducted focussed on the incorporation of environmental considerations in supplier and component selection decision-making. An extension of this research would be the investigation of how social, ethical or sustainability considerations can be included in the process. This would be particularly interesting for product evaluation. It would seem to be a natural progression from evaluation methodologies that have emerged from the findings of this research to those that include social impacts. Perhaps even LCA could be developed along these lines.

9.5.3 Analytical Techniques for Component Material Composition

The MSc research project that was supervised as part of this doctorate research yielded some interesting findings on suitable methods for analysing component material composition for validation purposes. However, it is clear that more research is needed in this area to attempt to develop an industry standard method that can be used by both organisations creating materials declarations and those validating or auditing them.

9.5.4 Material Technology Developments

Fundamental to improvements in environmental performance of products and processes within a manufacturing product-based environment is step change improvements in materials technology. The use of less hazardous substances along with recycled material and recyclable material contributes to the improved environmental performance of products. A considerable volume of research has, and is, being conducted on advancements in materials technology and this needs to continue. Interesting research areas include the development of shape-memory alloys and bio-degradable/edible product packaging. Currently of vital importance to the electronics industry is the identification and implementation of suitable replacements for lead-based solder and halogenated flame retardants. It is likely that environmental regulation (particularly substance bans) will continue to drive developments in new materials.

9.5.5 Product Environmental Profiles

It has been concluded that the creation of product material profiles for complex telecommunications products is not a simple process and requires the creator to establish certain rules that may limit the accuracy of the profile. Further research is required on how material profiles can be created for large volumes of products in an organisation and how the information can be best presented to a customer as part of a Product Environmental Profile.

References

Adams, G., (2001). Personal Communication.

Andersen, J. and Choong, H., (1997), *The Development of an Industry Standard Supply-Base Environmental Practices Questionnaire*, IEEE, ISEE, pp. 276 – 281.

Annema, J.A., Booij, H., Hesse, J.M., van der Meulen, A. and Slooff, W., 1996. Integrated criteria document fine particulate matter. Report No. 601014015. National Institute of Public Health and the Environment, Bilthoven, The Netherlands.

B&Q, (1998), *How Green Is My Patio – B&Q's Third Environmental Review*, B&Q, Eastleigh, Hampshire, UK.

Beckman, S., Worhach, P. and Sheng, P.S., (1995), *Environmentally-Conscious Supply Chain Management*, IEEE, ISEE, pp. 235 – 29.

Bell Canada Supply Services, 1996, *Environment Questionnaire SV 1216E – Issue 1 / 1996-07*, Bell Canada.

Bergendahl, C,G. and Segerberg, T., (1997), *Procurement of Components for Environmentally Compatible Electronic Products*, IEEE, ISEE, pp. 172 – 175.

Bergendahl, C.G., Ausen, D., Willum, O. and Turtola, A., (2000) *GreenPack: The Nordic model for achieving first class environmental performance in electronic supply chains*, Electronics Goes Green 2000+ - A Challenge for the Next Millennium, Conference Proceedings, pp. 593 – 596.

Bouma, R, 2000. Personal Communication.

Brink, S., Diehl, J.C. and Stevels A. (1998) *Eco-Quest, An Ecodesign Self Audit Tool for Suppliers of the Electronics Industry*, IEEE, ISEE, pp. 129 – 132.

Business in the Environment (1994), *Buying into the Environment – Guidelines for Integrating the Environment into Purchasing and Supply*, Business in the Environment, London.

Business in the Environment and The Chartered Institute of Purchasing and Supply (1997), *Buying into a Green Future – Partnerships for Change*, Business in the Environment, London.

Chambers, G.C. and Cox, D.G. (1996) *Meeting OEM Customer Product Environmental Performance Expectations through Environmental Product Design (EPD) Roadmaps and Specifications*, IEEE, ISEE, pp. 242 – 247.

Charters, M. (1999), ETMUEL Project.

Ching, S., Jacques, M., Kirby, J.R. and Mann, T., (1998), *Development of a Comprehensive Product Environmental Profile System*, Care Innovation '98 Proceedings, pp. 369 – 376.

Choong, H. (1996) *Procurement of Environmentally Responsible Material*, IEEE, ISEE, pp. 236 – 241

Clark, T. and Charter, M. (1999), *Eco-Design Checklists - For Electronic Manufacturers, 'Systems Integrators', and Suppliers of Components and Sub-assemblies,* Centre for Sustainable Design, Farnham,UK.

Craig, E. and Shiovitz, A. (1997), *Not Another Survey!!!! How Sun Microsystems Tackled Its Customer Environmental Inquiry Response Problem Using Quality Processes,* IEEE, ISEE, pp.267-271.

Crosbie, L. and Knight, K., (1995), *Strategy for Sustainable Business – Environmental Opportunity and Strategic Choice,* Chapter 9 Procurement and Logistics Strategies, pp. 179 – 195, McGraw-Hill, Maidenhead, UK.

Department of Environment Transport and the Regions, (2001), *Multi Criteria Analysis: A Manual.*

Department of Trade and Industry, (1999), *Life Cycle Assessment and Life Cycle Financial Analysis of the Proposal for a Directive on Waste from Electrical and Electronic Equipment,* Report by Ecobalance UK and DMG Consulting.

EC, (1996). *Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No. 1488/94 on risk assessment for existing substances, 2nd part,* Brussels, Commission of European Communities, Directorate-General Environment, Nuclear Safety and Civil Protection.

EC, (2003a), *Directive of the European Parliament and of the Council on Waste Electrical and Electronic Equipment,* Official Journal of the European Communities, 19.12.2000, C 365 E/184-194.

EC, (2003b) *Directive of the European Parliament and of the Council on the Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment,* Official Journal of the European Communities, 19.12.2000, C 365 E/195-197.

EC, (2002), *Proposal for a Directive of the European Parliament and of the Council on Establishing a Framework for Ecodesign of End-Use Equipment, Draft.*

Ecobalance UK and DMG Consulting Ltd, (1999), *Life Cycle Assessment and Life Cycle Financial Analysis of the Proposal for a Directive on Waste from Electrical and Electronic Equipment,* DTI, London, UK.

Electronic Industries Alliance, (1999), Compendium of Design for Environment Efforts of the Electronics Industry, Draft Copy, 9 July, 1999.

Electronic Industries Alliance, (2000), *Draft Substances Template,* Not published.

Electronics Industries Alliance, (2000), *Draft Material Declaration Template,* 08/11/2000.

Electronics Weekly, (2000), *"Salvage"* – interview with B. McLean (Newhouse Electronics) by M. Reynolds, Electronics Weekly, January 19 2000, p.18.

Elsie, D. (1997), *Hewlett Packard's Approach to Customer Requests for Product and Process Environmental, Health and Safety Information,* IEEE, ISEE, pp.272 – 275.

Environmental Defense Fund, (1999). *Score card, chemical profiles.* http://www.scorecard.org/chemical-profiles/

Fairman, R., Mead, C.D. and Williams W.P., (1998). *Environmental Risk Assessment: Approaches, Experiences and Information Sources*, European Environment Agency, Office for Official Publications of the European Communities. Luxembourg.

FAO/WHO, (1993), *Evaluation of Certain Food Additives and Contaminants. Forty-First Report of the Joint FAO/WHO Expert Committee on Food Additives.* WHO technical report series 837. Geneva, Switzerland.

FAO/WHO, (1998), *Inventory of IPCS and other WHO pesticide evaluations and summary of toxicological evaluations performed by the Joint Meeting on Pesticide Residues through 1998*. Geneva, Switzerland..

FAO/WHO, (1999), *Evaluation of Certain Food Additives and Contaminants. Joint FAO/WHO meeting on pesticide residues in Rome, 20-29 September 1999.* Geneva, Switzerland..

Farrell, J., (2001), Personal Communication.

Fiksel, J. (1996), *Design for Environment – Creating Eco-Efficient Products and Processes,* McGraw-Hill, New York.

Francis, D., (1998), *Models for Life Cycle Assessment in the Telecommunications Industry*, Engineering Doctorate Portfolio Thesis, Brunel University.

Gabriel, J., Jacques, M., Kirby, J.R., Mann, T. and Pitts, D., (2000), *Integrating Environmental Requirements into the Supply Chain: IBM's ECP Initiatives*, Electronics Goes Green 2000+ - A Challenge for the Next Millennium, Conference Proceedings, pp. 587 – 591.

Graedel, T.E. and Allenby, B.R., (1995), *Industrial Ecology*, Prentice Hall, New Jersey.

Granda, R.E., Hermann, F., Hoehn, R. and Scheidt, L-G, (1998), *Product-related Environmental Attributes ECMA TR/70 – an Update*, IEEE, ISEE, pp. 1 – 3.

Green, K., Morton, B. and New, S., (1998), *Green Purchasing and Supply Policies: Do They Improve Companies' Environmental Performance?,* Supply Chain Management Volume 3 Number 2, 1998, pp. 89-95.

Guinee, J., Heijungs, R., van Oers, L., van de Meent, D., vermeire, T. and Rikken, M. (1996). *LCA impact assessment of toxic releases. Generic modelling of fate, exposure and effect for ecosystems and human beings with data for about 100 chemicals.* Ministry of Housing, Spatial Planning and the Environment (VROM). Report No. 1996/21. The Hague, The Netherlands.

Hammra, C. and Collins, H., (1999), *i2004 Environmental Programme Proposal*, Internal Nortel Networks Report.

Heijungs, R., (Final Editor), (1992), *Environmental Life Cycle Assessment of Products – Backgrounds*, Centre of Environmental Sciences, Leiden.

Hendrickson, C.T., Horvath, A., Joshi, S., Klausner, M., Lave, L.B., McMichael, F.C., (1997), *Comparing Two Life Cycle Assessment Approaches: A Process Model – vs. Economic Input-Output-Based Assessment*, Proceedings of the International Symposium on Electronics and the Environment, 1997, pp. 176 – 181.

Huijbregts, M.A.J.,(1999b). *Toxic effect factors for the terrestrial environment in the frame of LCA*, Interfaculty Department of Environmental Sciences, Amsterdam, The Netherlands.

Huijbregts, M.A.J., (1999), *Priority Assessment of Toxic Substances in the Frame of LCA – Development and Application of the Multi-Media Fate, Exposure and Effect Model USES-LCA*, PhD, Interfaculty Department of Environmental Science, University of Amsterdam.

IBM (1999), *1998 Environment Report.*

Janssen, P.J.C.M, van Apeldoorn, M.E., van Engelen, J.G.M., Schielen, P.C.J.I. and Woters, M.F.A. (1998). *Maximum permissible risk levels for human intake of soil contaminants: fourth series of compounds.* Report No. 711701004. National Institute of Public Health and the Environment, Bilthoven, The Netherlands.

Janus, J.A., Hesse, J.M. and Rikken, M.G.J. (eds), (1994), *Aandachstoffen in het Nederlandse milieubeleid. Overzicht 1994.* Report No. 601014006. National Institute of Public Health and the Environment. Bilthoven, The Netherlands.

JECFA, (1982), *Toxicological evaluation of certain food additives and contaminants. The 30th meeting of the joint FAO/WHO expert committee on food additives.* International programme on chemical safety. World Health Organisation, Food Additives Series 17. Geneva, Switzerland.

JECFA, (1986), *Toxicological evaluation of certain food additives and contaminants. The 33rd meeting of the joint FAO/WHO expert committee on food additives.* International programme on chemical safety. World Health Organisation. Food Additive series 21, Geneva, Switzerland.

JECFA, (1989), *Toxicological evaluation of certain food additives. The 24th report of the joint FAO/WHO expert committee on food additives.* International programme on chemical safety. World Health Organisation, Food Additive Series 24, Geneva, Switzerland.

Johnson, M., (2002), *Evaluating Remanufacturing and Demanufacturing for Extended Producer Responsibility and Sustainable Product Management*, University of Windsor, Windsor, Canada.

Lizotte, R.P., (1995), *Life Cycle Assessment as a Communication Tool in Customer-Supplier Relationships*, IEEE, ISEE, pp. 240 – 244.

Lucent Technologies (1998), *1997 Environment, Health and Safety Report.*

Malhammar, G., (1998), *Materials Declaration Questionnaire*, IEEE, ISEE, pp. 14 – 17.

Malhammar, G., (2000), *A Data Tool for Materials Declaration*, Electronics Goes Green 2000+ - A Challenge for the Next Millennium, Conference Proceedings, pp. 517 – 520.

Matzke, J.S., Chew, C. and Tse-Sung Wu,(1997), *A Simple Tool to Facilitate Design for the Environment at Apple Computer*, Proceedings of the International Symposium on Electronics and the Environment, 1998, pp. 202 – 206.

Maxie, E.(1994) *Supplier Performance and the Environment*, IEEE, ISEE, pp. 323 - 327.

Mayer, K, (1997), *The Role of Supplier Evaluation and Product Life Cycle Assessment in Product Development in the Body Shop International*, The Journal of Sustainable Product Design, April 1997, pp. 50 –52.

Middendorf, A., Nissen, N.F., Griese, H., Muller, J., Potter, H., Reichl, H. and Stobbe, I., (2000), *EE-Toolbox – A Modular Assessment System for the Environmental Optimisation of Electronics*, Institute of Electrical and Electronic Engineers, International Symposium on Electronics and the Environment, 8-10th May 2000, San Francisco, California, pp. 166 – 171.

Mulder, L. (1998) *Green Purchasing: Does it Make Sense*?, IEEE, ISEE, pp. 123 – 128.

Nagel, M.H. (1998a), *Environmental Quality in the Supply Line: a New Approach*, IEEE, ISEE, pp. 180 – 185.

Nagel, M.H., (1998b) *Environmental Supply-Line Engineering: Eco-Supplier Development Coupled to Eco-Design – A New Approach*, Bell Labs Technical Journal, April – June 1998, pp. 109 – 123.

Nagel, M.H., (1999), *Environmental Quality, Environmental Management Systems and Environmental Performance Related to Procured Printed Circuit Boards of an Original Equipment Manufacturer*, IEEE, ISEE, pp. 325 – 330.

Nagel, M.H., (2000a), *Environmental Supply-Chain Management versus Life Cycle Analysis (LCA) Method Eco-Indicator '95: A Relative Business Perspective versus an Absolute Environmental Perspective*, IEEE, ISEE, pp. 118 – 123.

Nagel, M.H., (2000b), *Environmental Supply-Chain Management versus Green Procurement in the Scope of a Business and Leadership Perspective*, IEEE, ISEE, pp. 219 – 224.

Nagel, M.H., (2000c), *Environmental-Economic Assessment Methods in the Supply Chain Management Approach of an Original Equipment Manufacturer (OEM) of Telecommunication Products: an Overview*, Electronics Goes Green 2000+ - A Challenge for the Next Millennium, Conference Proceedings, pp. 597 – 603.

Nagel, M.H., (2001), Personal Communication.

NEMI (National Electronics Manufacturing Initiative), (2000), *NEMI Technology Road-Map*.

Nissen, N.F., Griese, H., Middendorf, D., Muller, J., Potter, H. and Reichl, H., (1997) Environmental Assessments of Electronics: *A New Model to Bridge the Gap Between Full Life Cycle Evaluations and Product Design*, Proceedings of the International Symposium on Electronics and the Environment, 1997, pp. 182 – 187.

Nortel Networks, (1994), *Corporate Standard 180.52 Supplier Reliability Process Questionnaire.*

Nortel Networks, (1995), *Corporate Standard 180.61 General Audit and Quality System Report.*

Nortel Networks, (1995), *Corporate Standard 180.65 Supplier Environmental Assessment.*

Nortel Networks, (1998), *Beyond Good Corporate Citizenship: The Environment as a Competitive Opportunity*, Issue 1 (internal report).

Nortel Networks, (1999a), *Corporate Standard 180.60 Part Selection and Management Process Commodity and Technology Assessment.*

Nortel Networks, (1999b), *Corporate Standard 180.40 Supplier and Parts Management.*

Nortel Networks, (1999c), *Corporate Standard 180.50 Supplier Auditing and Qualification.*

Nortel Networks, (1999d), *DMS Family Technical File, Section 2 General Product Description, Issue 2.*

Nortel Networks, (1999e), *DMS100E Eco-Compliance Assessment For European Union 3rd Draft WEEE Directive For DMS Equipment NTRX30CA, NT9X01JB, NT9X01MB, NT9X05AC, NTRX31CA and NT9X70BB* Internal report.

Nortel Networks, (2001), http://www.nortelnetworks.com/corporate/community/environment/life_cycle/index.html.

Office of Government Commerce and Department of Environment, Food and Rural Affairs, (2002), *Environmental Issues in Purchasing,* http://www.defra.gov.uk/environment/greening/greenpro/greenpro.htm

Philips Electronics (1999), *Ecovision – 1998 Environment Report.*

Poyner, J., (1997), *The Integration of Environmental Information with the Product Development Process Using an Expert System,* PhD Thesis, Manchester Metropolitan University.

Pre Consultants, (2002) *Qualitative Guidelines for Designers,* **http://www.pre.nl/ecodesign.htm**, Netherlands.

Riza, (1999). *Effect factors for the aquatic environment in the frame of LCA.* Haskoning, Nijmegen. National Institute of Public Health and the Environment, Bilthoven. Interfaculty Department of Environmental Science, Amsterdam, The Netherlands.

Roberts, H and Robinson, G, (1998), *ISO 14001 Implementation Handbook,* Butterworth Heinemann, Oxford.

Sarkis,J., Darnall, N.M., Nehman, G.I. and Priest, J.W. (1995) *The Role of Supply Chain Management within the Industrial Ecosystem,* IEEE, ISEE, pp. 229 – 234

Stuart, J.A., (1998), *Materials Selection for Life Cycle Design,* IEEE, ISEE, pp. 151 – 157.

TemaNord, (1995). *Waste from electrical and electronic products: a survey of the contents of materials and hazardous substances in electric and electronic products,* Nordic Council of Ministers, Copenhagen, Denmark.

Vermeire, T.G., (1993), *Voorstel voor de humaantoxicologische onderbourwing van C-(toetsings)-waarden. Betreft addendum op rapport No. 715801001.* National Institute of Public Health and the Environment, Bilthoven, The Netherlands.

Vermeire, T.G., van Apeldoorn, M.E., de Fouw, J.C. and Janssen, P.J.C.M., (1991). *Voorstel voor de humaantoxicologische onderbouwing van C-(toetsings)waarden. Report No. 725201005.* National Institute of Public Health and the Environment, Bilthoven, The Netherlands.

Warmington, A. (1980), *Action Research: Its Methods and Its Implications,* Journal of Applied Systems Analysis (7), pp. 23-39.

Waters, S., (2001), Telecoms Bubble Bursts, Financial Times Article, Financial Times Web Site, 8 July 2001.

Whitaker, B. (1995) *Harmonising Environmental Management Throughout the Supply Chain*, IEEE CONCEPT Conference, pp. 182 – 185.

White, S. (1997), *Design for Environment Guidelines for Nortel Physical Designers*, Systems Packaging Document No. SP GP 2410, Issue 1, March 3 1997.

Widdowson, S., (2000), *The Determination of the Material Composition of a Selection of Electronic Components Supplied to Nortel Networks*, MSc Thesis, Brunel University.

Appendix I.

Ecodesign Checklists

Appendix I Ecodesign Checklists

GENERAL ECO-DESIGN CHECKLIST (Clark and Charter, 1999)

For each issue or life cycle stage consider appropriate design objectives or attributes, and whether these have been met or adequately considered.

No	Design considerations	Y	N	N/A	Comments
A	ENVIRONMENTAL CONCERNS/ISSUES				
1	Are the environmental aspects/impacts of the component/assembly or design judged to be significant (ie of actual/potential concern) by virtue of a) Regulatory requirements (eg draft WEEE Directive see A.2 below) b) Customer requirements c) Environmental load (eg quantity, toxicity, energy consumption) d) Other Considering i) Materials sourcing ii) Manufacture and distribution iii) Use iv) 'End of life'				
2	Is the WEEE Directive potentially relevant? (see Checklists 4.3and 5.3) a) Relevant appliance applications b) Relevant hazardous substances c) Plastic parts weigh more than 25grams? (require materials coding) d) The component/assembly creates other problems for 'end of life' disassembly, recovery, recycling or disposal? (Is disassemly easy? Are materials recyclable)				
B	SYSTEM DESIGN Have the following been considered?				
1	Design for simplicity - reduced complexity of enclosures and assemblies - fewer parts - multifunctional parts eg single fastener - using common parts in different designs				
2	Design of multifunctional products - parallel (several purposes for same product) - sequential (product retired to secondary use)				
3	Design for source reduction (reduced mass)				

	- reduction of physical dimension - lighter weight materials - thinner enclosures - reduced mass of key components - reduced weight or complexity of packaging - electronic documentation				
4	Design for longevity - is longevity feasible? - does durability mean denser materials and compromise disassembly and recovery?				
C	**MATERIALS SOURCING**				
1	Are recycled materials specified where possible? - for product materials - for packaging Is this economically and technically feasible?				
2	Are scarce resources avoided?				
3	Are materials form environmentally responsible raw material conversion, manufacturing processes or suppliers?				
4	Are hazardous materials minimised/avoided?				
D	**MANUFACTURING AND DISTRIBUTION**				
1	Is the component/assembly designed for energy conservation - in manufacture - in distribution logistics				
2	Is the component/assembly designed for waste minimisation in manufacture Are usable containers used?				
3	Is the component/assembly designed to minimise the following in the manufacturing process - air and water pollution - water use - materials use				

	- other environmental effects				
E	**USE** Is the product designed for				
1	Minimum power consumption in use?				
2	Minimum packaging?				
3	Minimum consumable use?				
3	Minimum waste consumables in use (eg batteries)?				
4	Serviceability (replacement of parts without disposing of whole assembly or equipment)				
5	Longevity ?				
6	Durability ? Does durability mean denser materials and compromise disassembly and recovery				
7	Accident prevention				
F	**'END OF LIFE': Design for re-use, disassembly and recycling**				
1	Is **component** recovery feasible? Is there a market? If so, has design for disassembly and component recovery been considered, including a) Design for non-destructive removal b) Design for speedy diagnosis and refurbishment c) Design for closed loop manufacturing d) Design for use in secondary applications				
2	Is **material** recovery feasible or required? - Is there a market for the material? - Is there separation and recycling technology and infrastructure? - Is there any other requirement for material separation (eg removal of hazardous materials before disposal)? If so has design for disassembly, separability and material recovery been considered, wherever possible and without compromising safety and performance?				

	Consider the following				
3	Have the following been specified or achieved? a) Materials - Material combinations compatible for recycling - Use of recyclable materials (or at least 60% of the total) - Grouping hazardous or non recyclable components - Aluminium in preference to steel - 'Commonly used' rather than 'exotic' materials - Thermoplastics in preference to thermosetting materials (eg rubber, GRP, CF composites) - Use of compatible polymers (eg PC and ABS) - use of integral finishes and labels **b) Assembly/ disassembly methods** Is the component/ assembly designed for ease of assembly and for separability? - Simple component mechanisms and orientation - Provision for grasping parts - Use of screws in preference to rivets - 'Snap fit' or spring clips in preference to threaded fasteners where possible - Common fasteners - Fastening points accessible, visible and clearly marked - Use of standard screwheads - Screws which are in contact with mouldings easy to get at - Use of alternative bonding methods - Use of detachable leads and push in plugs rather than solder - Value parts easily accessible? - Moulded-in inserts made of compatible materials - Where incompatible materials have been used, inserts easily broken off? - Assemblies and components removable with a standard tool? - 'Break out' points been designed into mouldings? **c) Information** - Material coding symbols moulded into plastic parts in accordance with ISO 11469 - Type and grade of cast materials moulded or stamped on items as appropriate, and located				

	such that subsequently not machined off? - Non-toxic substances in preference to toxic - Toxic substances labelled - Integral finishes and labels - Stamping, engraving, moulding, etc in preference to labelling - Instructions/ information to customers, equipment producers, recyclers on dismantling				
4	Have the following been **minimised**? - Component count - Material mass - Number of different materials - Non-recycable materials - Number of connection points - Number of fasteners - Number of fastener variations - Fasteners of materials compatible with parts connected - Screw connections? - Numbers and types of screws - Adhesives and welds between components which may be separated or between incompatible materials				
5	Have the following been **avoided** ? - Mechanisms which complicate assembly/disassembly - Moulded-in metal inserts/parts in plastics - Nuts and bolts - Deep access holes for screws - Dissimilar metal inserts in aluminium - Adhesives incompatible with the parts being joined - Thermosetting materials - Painted parts - Use of labels on recyclable items - Adhesive-backed foams				

PRé Consultants - Qualitative Guidelines for Designers

1. Do not design products
Do not design "green" products but design environmentally sound product life cycles. That is to take into account all processes that occur during the life cycle, from cradle to grave, or better, from cradle to cradle.
A simple way to document your findings is the MET matrix (MET= Materials, Energy, Toxicity). Just write down some of the most important facts in a matrix as indicated below.

The MET Matrix Materials Energy Toxicity
Production ... ...
Use ... ...
Disposal ... ...

2. Natural materials are not always better
It is commonly believed that "natural" materials are preferred above "artificial" or man made materials. Of course the production of 1 kg of wood causes less emissions than the production of 1 kg of plastic. But have you thought about the paint, the sawing losses? In some products you would need about ten times as much wood as plastic. Plastic can be recycled, wood cannot. Can you really compare on a kilogram basis?

3. Energy consumption: underestimated
Many designers focus their attention on material selection. This is not always justified. If a product consumes energy in the use phase, there is a ten to one chance that energy consumption is dominant. People normally underestimate the environmental impacts of energy.
Perhaps these simple examples may help you:

10 kWh electricity uses 2 kg of oil
1 kg of plastic uses 1,5 to 2,5 kg of oil
A coffee machine uses 300 kWh electricity during its lifetime, equal to 60 kg of oil. During production only 2 kg of plastic is used.

4. Increase product life time
A designer can influence the product life time in several ways. Make it more durable from a technical point of view, make it upgradeable (allowing to place the latest chip in a computer or washing machine).
More important, try to design the product in such a way people will feel attached to it. Many products are not thrown away because they are broken, but because people got bored with them.

5. Do not design products but services
People do not always want a product. They want a solution for a certain problem. Sometimes a service can be a good solution, like the launderette, instead of many

individual washing machines. A good example is also the various car sharing systems currently setup in the Netherlands.

6. Use a minimum of material
This may seem obvious, but it is more complex than you think. Often it is possible to reduce the amount of material by critically looking at dimensions, required strength and production techniques.
It can even be beneficial to use materials that have a high environmental load per kilogram, if you can save weight. This is particularly true in transport equipment, where less weight means less fuel consumption. The Eco-indicator method is well suited to make such assessments.

7. Use recycled materials
Do not only make your product recyclable, but use recycled material. If every designer only makes products recyclable, there will never be a demand for recycled materials in the future. If there is a demand for recycled materials the supply will follow certainly.

8. Make your product recyclable
Most products could be recycled, but only few will. Only products that are disassembled easily and have a high enough yield will be chosen for recycling . A designer can increase the chance that the product is recycled by optimizing its design.
The steel part of a car is recycled; the plastic parts are normally not recycled as various plastics are used. However the Volvo's made in Holland have a bumper that is made of one type of PP without a lacquer. It is very beneficial to recycle these parts when taken from a car in a few seconds.

TV's can be recycled. It is even economical to recycle the plastic housing since is contains a high grade and therefore expensive plastic. Philips is recycling the glass of TV screens.

There are a few simple rules to keep in mind.

If you want to recycle thermoplastics:
-Do not use a lacquer
-Do not paste paper stickers on the plastic
-Do not combine different plastics. Particularly do not mix PVC and nylon in other plastics.

If you want to recycle steel parts, be careful not to get to much copper in the melt.

If you want to recycle thermo-sets or textile, think twice. It has no use. It is better to burn them and reclaim the energy.

9. Ask stupid questions!

Very often decisions are based on common practice: "we have always done it this way and it worked well". We made huge improvements in the environmental performance of products, by simply asking the very obvious. We use the stupid question as a tool.
A company used 3 kg of raw material to make 1 kg polyester. After asking the same stupid question ("why") again and again, it was discovered it could be done in another way, wasting just less than 500 gram.
A company makes a packaging that should keep the contents fresh for 18 months. After some critical questions it was discovered that their products were consumed within 3 months. This gave way for completely different solutions.
Rainwater piping traditionally has a diameter of 80 mm in the Netherlands. After studying building regulations and a simple optimization of the hydraulic properties of the water inlet, we found 30 mm was sufficient.

Appendix II.

Nortel Networks Customer Environmental Questionnaire.

Appendix II Nortel Networks Customer Environmental Questionnaire

Category 1 – The Objectives of your Requests for Environmental Information

	Office Use Only
Q.1. What are your drivers for obtaining environmental information from Nortel? ☐ ISO 14001[A1] ☐ Policy[A2] ☐ Legislation[A4] ☐ Stewardship[A8] ☐ Marketing/Customer requirements[A16] ☐ Other (please specify below)...[A32]	
Q.2. Does your company consider company or product environmental performance as a competitive issue? Company: ☐ Yes[B1] ☐ No[B2] Product: ☐ Yes[B4] ☐ No[B8]	

Category 2 – Your Supplier Questionnaire

	Office Use Only
Q.1. Are metrics in place to assess Nortel's environmental performance from the answers provided in your questionnaire? ☐ Yes[C1] ☐ No[C2]	
Q.2. Are the questions in your questionnaire weighted in any way? ☐ Yes (go to Q.3.)[D1] ☐ No (go to Q.5)[D2]	
Q.3. How are the weightings derived?[E1] (Please continue over leaf)	

Q.4. Is there a minimum score for bid approval? ☐ Yes[F1] (Please specify ________) ☐ No[F2]	
Q.5. If metrics are not used, what aspects of environmental management are considered most important? (please circle) >>>>>Increasing importance >>>>> Company Policy 1 2 3 4 5[G1] Environmental Management System 1 2 3 4 5[G2] Product (Design for Environment) 1 2 3 4 5[G4] Product Take-back (end-of-life) 1 2 3 4 5[G8] Site performance 1 2 3 4 5[G16]	

Category 3 – Use of Your Supplier Questionnaire Results

	Office Use Only
Q.1. How does environmental performance compare in importance to other selection criteria in the bid process? (please circle) >>>>>Increasing importance >>>>> Cost 1 2 3 4 5[H1] Quality 1 2 3 4 5[H2] Company stability 1 2 3 4 5[H4] Technology 1 2 3 4 5[H8] Service 1 2 3 4 5[H16] Reliability 1 2 3 4 5[H32] Warrantee 1 2 3 4 5[H64] Environmental performance 1 2 3 4 5[H128]	

Q.2. Does the company envisage environmental performance becoming increasingly significant in the supplier selection process? ☐ Yes[I1] Go to Q.3 ☐ No[I2] Go to Q.4	
Q.3. Can you specify when environmental performance is likely to be significant in the supplier selection process? ☐ 1Year[J1] ☐ 1 – 2 Years[J2] ☐ 2 – 3 Years[J3] ☐ 3 – 4 Years[J4] ☐ Never[J5]	
Q.4. Do you envisage a point in time when ISO 14001 accreditation will be considered a satisfactory indicator of supplier environmental performance/commitment? ☐ Yes[K1] Go to Q.5. ☐ No[K2] Go to Q.6.	
Q.5. Would your company then consider product specific environmental performance as a specific differentiator between products on the market. ☐ Yes[L1] ☐ No[L2]	
Q.6. Would you consider a voluntary declaration or eco-label sufficient for product environmental imformation (e.g. ECMA, SITO, Blue Angel, Nordic Swan etc..)? ☐ Yes[M1] (Please specify below) ☐ No[M2]	

Thank you for completing the questionnaire. Please return it to Carl Mead, Environmental Research Engineer, Materials and Design Technology, Nortel Technology, Harlow, Essex, CM17 9NA, UK.

Appendix III.

Questionnaires from Selected Customers

Impact on the environment

Bell Canada is committed to environmental protection. As part of its environmental program, the company is asking its supplier community to participate in the spirit of this commitment. As such, the company will seek out suppliers who can demonstrate that they have made serious and sustained efforts to minimize the environmental impacts of their operations, products and services. The questionnaire allows potential suppliers to demonstrate to Bell Canada the extent of their commitment to environmental protection.

Part A of the questionnaire focuses on the overall approach to structuring an environmental program. This includes establishment of policy, resource allocation and identification and management of environmental issues; in short, the state of evolution of the company's Environmental Management System. In this respect, companies are encouraged to avail themselves of existing guidelines for the establishment of Environmental Management Systems (such as those available from the Canadian Standards Association), and to ultimately align their systems with the ISO 14000 series of EMS documents, scheduled for publication in 1996.

Part B of the questionnaire measures whether a supplier has accepted Product Stewardship responsibilities. Bell Canada supports the concept of Product Stewardship. This may be briefly stated as the expectation that those who bring a product or service to market (typically the manufacturer) will bear a share of the responsibility for minimizing the environmental impacts at all stages of the product life cycle from manufacturing through to final disposal.

Please note that each question is worth a certain number of points, with a possible maximum score of 100.

Potential suppliers should recognize that their score will be one consideration in the supplier selection process, along with price, delivery time, performance, quality and other factors. This questionnaire reinforces our position that suppliers can gain a competitive advantage by demonstrating the superior environmental performance of their operations, and their products and services.

PART A: ENVIRONMENTAL PROGRAM

To complete this questionnaire simply enter the appropriate score for your answer in the right hand box.

Score

1. Has a written preparatory environmental review of your company been carried out ? Yes (8) No (0)

2. Have you a written environmental policy statement signed at Company Director level ? Yes (4) No (0)

3. Is overall responsibility for environmental issues at Company Director level ? Yes (2) No (0)

4. Have you allocated responsibilities to implement the policy ? Yes (2) No (0)

5. Have you allocated resources to implement the policy ? Yes (2) No (0)

6. Do environmental issues form part of the training program for all staff ? Yes (3) No (0)

7. Is there a mechanism in place within the company to deal with public inquiries and concerns with respect to environmental matters ? Yes (2) No (0)

8. Have you identified and documented:

   a) Legislation relevant to the environment aspects of your company's operations ? Yes (2) No (0)

   b) The significant environmental aspects and impacts, associated with your company's activities, products and services ? Yes (2) No (0)

9. Have you set yourselves quantified objectives and targets for environmental improvement ? Yes (7) No (0)

10. Do you have you a plan for implementing these objectives and targets with set time frames ? Yes (5) No (0)

Score

11. Do you make the following available to the public:
    a) Your Environmental Policy Statement ? Yes (2) No (0) ☐
    b) Your objectives, targets and progress on achievements ? Yes (2) No (0) ☐
    c) Your company's listing of environmental aspects and impacts ? Yes (2) No (0) ☐

12. Do you have a written, formal, environmental management system ?
    Yes (3) No (0) ☐

13. Does your management system include the environmental appraisal of suppliers and sub-contractors, including waste disposal contractors ?
    Yes (4) No (0) ☐

14. Has the management system been implemented on :
    a) site basis (1) or
    b) a national basis (2) or
    c) a company-wide basis (3) ?
    Companies with only one site, answer c) ☐

15. Has an on-going environmental audit and review program been implemented ? Yes (5) No (0) ☐

Potential suppliers are asked to respond to the following question, for which no points are awarded.

16. Has your company been convicted of an environment related offense, or does it have any pending environment related notices of infraction or litigation ? Yes_____ No _____

    If yes, provide brief details below.

____

____

____

____

Score Part A (Maximum 60) ☐

PART B: PRODUCT STEWARDSHIP

To complete this questionnaire simply enter the appropriate score for your answer in the right hand box.

Score

1. Has a full cycle environmental evaluation been carried out on the product or service you are offering:
   a) Identifying Life Cycle stages ? Yes (1) No (0) ☐
   b) Identifying environmental effects ? Yes (3) No (0) ☐
   c) Including measurement of significant environmental effects ? Yes (3) No (0) ☐

2. Is the product labeled to inform the user of any relevant environmental information such as disposal information ? Yes (2) No (0) ☐

3. Have your packaging designers used the "Canadian Code of Preferred Packaging Practices" guideline, or equivalent (Specify________________), in designing the packaging ? Yes (2) No (0) ☐

4. Is the packaging for the item:
   a) The minimum necessary for protection ? Yes (2) No (0) ☐
   b) Of recycled material ? Yes (1) No (0) ☐
   c) Capable of being recycled ? Yes (1) No (0) ☐
   d) Re-usable ? Yes (2) No (0) ☐

5. Has the product been produced from recycled materials ? Yes (4) No (0) ☐

6. Is the item designed for disassembly and recycling ? Yes (4) No (0) ☐

7. To what extent can the product be recycled ?
   (This should be both practically and economically feasible)
   Extent by weight is greater than or equal to:
   a) 20% (1) or b) 40% (2) or c) 60% (3) or
   d) 80% (4) or e) 100% (5) ☐

8. Is there a return loop in place - an existing logistical route to return the item to the supplier or its agent for:
   a) Responsible disposal? Yes (4) No (0) ☐
   b) Recycling? Yes (6) No (0) ☐

 Confidential when filled, keep this document as quality record

Suppliers are asked to answer to the following questions, for which no points are awarded.

9. Is the product or service you wish to supply free from any emissions to air or water which have an adverse environmental effect when in use or during maintenance, such as emissions of solvents: CFCs, NOx, Sox, CO, ozone, particulate, carcinogens, hydrocarbons and so on? Yes No ☐

   If no, please supply details for individual assessment by Bell Canada

   ____

   ____

   ____

   ____

10. Does the product contain any substances or material, that, at the end of its useful life would be classified as hazardous waste in the Canadian provinces of Quebec and Ontario? Yes No ☐

    If yes, please supply details separately for individual assessment by Bell Canada

    ____

    ____

    ____

    ____

Score Part B (Maximum 40) ☐

+ Score Part A (Maximum 60) ☐

= Overall Score (Maximum 100) ☐

CERTIFICATION OF ABOVE DATA

The information contained in this questionnaire is certified to be complete and accurate.

Name & Title: ______________________________

Telephone/Fax numbers: ______________________________

Attachments provided (Specify) ______________________________

Signature and Date : ______________________________

RESERVED FOR BELL CANADA

Questionnaire sent by/date: ______________________________

Received by/date: ______________________________

Additional information needed, See SV 1220 ______________________________

Specify: ______________________________

Further action: ______________________________

Remarks: ______________________________

Confidential when filled, keep this document as quality record

Request For Quotation

Point-to-Multipoint

Broadband Fixed Wireless Access

- General Safety and Environmental requirements for equipment and materials -

July 20, 1998

Department of infrastructure

Unisource Belgium

2.Requirements relating to the use of toxic substances

1.Unisource Belgium states that products and/or preparations in which the substances and preparations referred to in § 8.2.2.5 occur (such as, for example, PCBs) shall not be used unless expressly required by Unisource Belgium and the use of the substances and preparations referred to is not subject to a ban (for that particular application).

2.If use is permitted, these substances shall be embedded in such a way in the equipment that they do not present any problem in normal use (including maintenance) of the product in the worst conceivable case. These and possibly other substances as well, may, however, present problems if a fault occurs in the equipment or if the products enter the waste stage. A simple and safe procedure to be adopted in such a case shall be specified at the time of delivery.

3.The supplier has a duty to submit and carry out a reliable replacement and removal procedure for products and equipment - or components thereof - which have been delivered to Unisource Belgium by the supplier and which contain substances which are not, or are no longer, permitted by the regulations of the EEC or by national regulations for reasons of health or environmental risk.

If the termination of the permission for "reasons of health or environmental risk" is based exclusively on rules imposed by Unisource Belgium itself, Unisource Belgium may agree a reliable replacement and removal procedure with the supplier. A reliable performance of this procedure by or on behalf of Unisource Belgium does not affect any guarantee procedure.

4.These regulations are applicable for the agreed service life.

5.Substances which shall not be incorporated in operational and control equipment to be used by Unisource Belgium are, for example:

- beryllium and beryllium compounds (including heat-conducting paste based on beryllium oxide);
- toluene diisocyanate (2-methyl-1,4-phenylene diisocyanate);
- formaldehyde;
- asbestos and asbestos-containing products;
- epichlorohydrine;
- polycyclic aromatic hydrocarbons;
- benzidine;
- prohibited pesticides;
- chlorinated paraffins;
- PCB;
- PCP;
- PCPL;
- CFCs and their equivalents causing the greenhouse effect and depleting the ozone layer;
- substances causing lasting corrosion.

6.Substances of which limited use may be made in consultation with Unisource Belgium and subject to the prevailing legal requirements are:

- PVC and PVDC, particularly in products with a long life (10 years or more);
- mercury and mercury compounds
- adhesive joints between parts which have to be separated in the recycling process;

pigments based on heavy metals;
substances releasing harmful gases when burnt (for example chlorine).

1.Production of harmful substances and/or products

If products are delivered which produce harmful substances, for example gases, during normal use, the manufacturer shall inform Unisource Belgium of this prior to delivery.

Swedish Railways Environmental Questionnaire

1) The tenderer shall, in the tender, specify standards, prestandards and European directives, concerning environmental matters, the equipment offered supports.

*Question TRd0457: The tenderer shall, in the tender, specify standards used in the construction, showing what standard has been used for different parts of the equipment, from single component types to assembled units.

*Question TR0460: A description of the suggested material including adequate information on its properties shall be provided.

*Question TR0461: The contractor shall provide an environmental recycling diagram of all parts included in the delivered products.

*Question TR0462: Any parts, delivered by the contractor, to be recycled,hazardous to environment, shall by guarantee be taken care of by the contractor.

*Question TR0463: No substances, chemical or other additives,forbidden by Swedish or European law may exist in the manufacturing of the product or in the product.

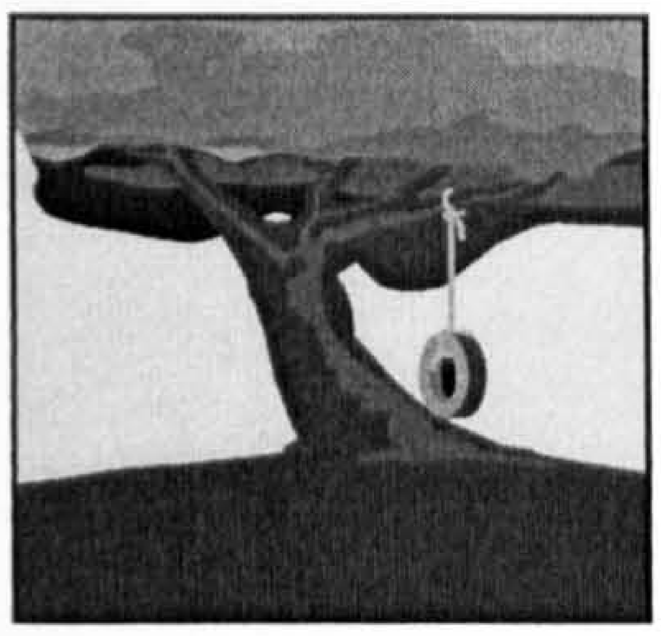
*Question TR0464: Units containing components with substances hazardous to health or environment must be marked with a warning label (black text on yellow background).

Date
1997-04-04

Reference

Division, name

NORMAL ECO-DECLARATION



Within Telia AB there is in full progress a development towards an increased environmental consciousness both with regard to the products which are marketed, and to the products which are used within the company. Telia AB has adopted an environmental program which among other things implies that ecological aspects in the buying activities shall be taken into consideration. Our objective is only to cooperate with contractors which in a serious and targeted way are working at minimizing environmental stress from their activities. As a part in this endeavour we collect the following information, which will constitute a part of the data on which a decision is based at selection of contractor.

Sections marked with a cross in the table of contents shall be answered!

TABLE OF CONTENTS

☐	**A ECO-MANAGEMENT SYSTEM 3**	**EVALUATION OF THE COMPANY**
☐	**B ECO-LABELLING 6**	**EVALUATION OF THE PRODUCT**
	C MANUFACTURING 7	**-"-**
	D USE...9	**-"-**
	E WASTE PRODUCTS 9	**-"-**
	F MATERIALS/SUBSTANCES.....................9	**-"-**
	G PACKING 9	**-"-**
	HERE THE GENERAL QUESTIONS CEASE. THE DETAILED. QUESTIONS BELOW SHALL BE ANSWERED IF NECESSARY.	
☐	**H ELECTRONIC CONSTRUCTION 9**	**EVALUATION OF THE PRODUCT, DETAIL QUESTIONS**
☐	**I BATTERIES..9**	
☐	**J RACKS/CABINETS/MECHANICAL STRUCTURE/MASTS....................................9**	**-"-** **-"-**
☐	**K PAPER PRODUCTS...................................9**	**-"-**
☐	**L MACHINE CONTRACTORS.....................9**	**-"-**

General information about the company:

Name of the company		**Organization number**	**Date**
Address	**Postal address**	**Telephone**	**Fax**
Contact	**Position**	**Telephone**	**Fax**
Reponsible for given information	**Position**	**Telephone**	**Fax**
Signature		**Clarification of signature**	

The Eco-declaration shall cover the products which are included in the offer. Please, specify these below:

No.	Products (or groups of Products)	Designation
1		
2		
3		
4		

[redacted]

DIRECTIONS

Immediately after each question there follows two or more answer alternatives of the type ***No, Yes*** *or the like. These shall be marked with an* ***X*** *in respective square. For columns there are sometimes certain answer alternatives given within brackets. A* ***(%)*** *indicates that the answer shall be given in per cent, and* ***(Y/N/?)*** *indicates that the answer shall be given with* ***Y*** *for* ***Yes***, ***N*** *for* ***No***, *or* ***?*** *for* ***Don´t know.***

For filling in the inquiry applies that part A shall only be answered once per company. As from part B the questions shall be answered per product (incl. subproducts), i.e. if you offer a number of products, the questionnaire shall be filled in for each product as from point B.

The answers to the questions shall be written directly in the Word document and be saved on diskette. *All answers shall be given directly in the space for the answers just below respective question. The space for answers will extend automatically and give more space if one proceeds writing when one has reached the end of the line.*

If more lines are wanted, this can be achieved by placing the cursor to the right of the bottom line and pressing Enter. Lines can be deleted by marking these and select "Cut" in the Edit-menu.

A ECO-MANAGEMENT SYSTEM

A.1 Have you introduced any Eco-management system ?

☐ Yes: Specify below:
☐ No

Company/Plant	Eco-management system[1]	Certification/Registration No.	Introduced, date

A.1.a If you have introduced an Eco-management system of your own, please describe below or enclose information separately.

Description of the Eco-management system

A.2 Have by you utilized contractors introduced any Eco-management system?

☐ Yes: some contractors, which in total represent ________ % of bought quantity. Specify below:
☐ No

Contractor/Plant	Type of contractor	Eco-management system[2]	Introduced, date

A.3 Are there any plans to introduce any Eco-management system?

☐ Yes: Specify below:
☐ No:

Company/Plant	Eco-management system[3]	Certification/Registration No.	Planned date

[1] EMAS, ISO 14001, BS 7750 or corresponding, and own internal system.
[2] EMAS, ISO 14001, BS 7750 or corresponding.
[3] EMAS, ISO 14001, BS 7750 or corresponding and internal system.

A.4 Has your company any written Eco-policy?

- [ ] Yes: Specify Eco-policy below:
- [ ] No: But we will have introduced a written Eco-policy: ____________ (date).
- [ ] No

Environ policy	Introduced date:

A.5 Has your company any written Eco-goals ?

- [ ] Yes: specify the most important (max 10) below:
- [ ] No: but we will have introduced written Eco-goals : ____________ (date).
- [ ] No

No	Eco- goals	Date[4]
1		
2		
3		
4		
5		

A.6 Has your company any written action programs to achieve the Eco-goals?

- [ ] Yes: specify briefly below your action programs to achieve the Eco-goals under A5:
- [ ] No: but we will have introduced written action programs to achieve the Eco-goals under A5: ____________ (date).
- [ ] No

No.	Brief account of your Eco-programs
1	
2	
3	
4	
5	

A.7 Do you report on the Eco-work in public?

- [ ] Yes: specify below, and enclose the latest issues:
- [ ] No: but we will report on the Eco-work in public as from: ____________ (date).
- [ ] No

Issue where the Eco-work is reported[5]	Date of the issue	Related to period

A.8 Are there any employees[6] appointed to work with Eco-questions?

- [ ] Yes: specify below:
- [ ] No

Name	Telephone	Position	Field of responsibility

[4] Date when the environmental goals are expected to have been fulfilled.
[5] In the annual report, separate report or other issue.
[6] Head of environmental section, environmental coordinator or the like.

A.9 Have the employees of the company had any Eco-training?

☐ Yes: specify below:
☐ No

Position	Number of persons	Number of days	Year[7]	Type of Eco-training

A.10 Are Eco-revisions performed at your company?

☐ Yes: regularly with ________ års intervall. Ange nedan:
☐ Yes: not regularly. Specify below:
☐ No

Performed by (Name and Company)	Telephone	Internal/External	Date, latest revision

A.11 Do you make Eco-demands on your most important contractors, beyond demands from laws and authorities?

☐ Yes: specify below:
☐ No

Contractor	Eco-demands

B

[7] Please, specify information of present year and two years back.

ECO-LABELLING

As from now on (section B), the questions shall be answered per product (incl. subproducts), i.e. if you offer a number of products, the questionnaire shall be filled in for each product as from point B.

If you offer a number of products, please copy the original Word file so that each product gets a separate Word file of its own. Do give the files names which can be associated with the product in question.

Specify product

B.1 Is the product marked with any voluntary Eco-labelling [8]?

☐ Yes: specify below voluntary Eco-labelling:
☐ No: no voluntary Eco-labelling exists for the product group.
☐ No

Products/Components	Eco-labelling	Registration No.	Introduced date

C

[8] For instance SIS Eco-labelling (the Swan), the EU-flower, Blauer Umweltengel (The blue angel), TCO 95, Energy Star (E*) etc.

MANUFACTURING

C.1 Does your activity require permission or other duty to notify according to Eco-protection legislation?[9]

☐ No
☐ Yes: Duty to notify.
☐ Yes: Permission. Specify permission below and enclose latest environmental report:

Decision-making authority	Date of decision	Name of the plant	The permission relates to	Type of permission [10]

C.2 Do there, at the manufacturing of the product, exist any substances listed by the Swedish National Chemicals Inspectorate in the List of restricted chemical substances in Sweden, the latest updating?

☐ No
☐ Don´t know
☐ Yes: specify substances and emissions, if any, and answer question C.3:

Chemical Symbol	Substance	Emission to air (Y/N/?)	Emission to water (Y/N/?)	Emission to earth (Y/N/?)
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐

C.3 Are you working at trying to limit the existence of the substances in the manufacturing which have been specified under question C.2?

☐ Yes: specify measurements for improvement below:
☐ No

Chemical Symbol	Substance	Measurements of improvement	Date [11]

C.4 Do you use detergents/degreasing compounds at manufacturing of the offered product?

☐ No
☐ Not relevant
☐ Yes: specify the detergents below:

Detergent/degreasing compound (active substance)	Product	Concentration	Used volume (estimated)

9 It may be doubtful to compare companies according to permission/duty to notify. Different rules are for instance in force in different countries, which may result in diffrent evaluation for the same environmental stress. The question therefore only shall be answered by Swedish companies.

10 Permission class A or B according to the directions of the National Swedish Environment Protection Board.

11 Date when the measurements of improvement are expected to have been introduced.

D

USE

D.1 Can there, at use of the product, occur emissions of any substances listed by the Swedish National Chemicals Inspectorate in the List of restricted chemical substances in Sweden, the latest updating?

☐ No
☐ Don´t know
☐ Yes: specify emissions of these substances to air, water and earth:

Chemical Symbol	Substance	Emission to air (Y/N/?)	Emission to water (Y/N/?)	Emission to earth (Y/N/?)
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐

D.2 Can use and maintenance of the product/subproduct cause known environmental and health hazards[12]?

☐ No
☐ Yes: specify below:

Environmental-/health hazard	Operating conditions, Comments	Product/subproduct

E

[12] For instance normal use, abnormal operating conditions, accident, repair/maintenance, fire etc.

WASTE PRODUCTS

E.1 Is the company connected to a system for re-use or recycling of material of the product?

☐ Yes: ____________ % of the product is included. Specify below:
☐ No

System	Description	Product/subproduct

E.2 Has there, at the construction of the product, any measures been taken to facilitate recycling[13]?

☐ Yes: for ____________ % of the product such measures have been taken at the construction. Specify below.
☐ No

Construction measures to facilitate recycling	Product/subproduct

E.3 Is there any information[14] available to facilitate recycling[15]?

☐ Yes: for ____________ % of the product such information is available. Specify below.
☐ No

Information to facilitate recycling	Source of information, Language	Product/subproduct

E.4 Are all plastic parts marked according to ISO 11469?

☐ Yes
☐ Not relevant
☐ No If no, specify part, type of plastic and reasons:

Part	Type of plastic	Statement of reasons

E.5 The marking of the product, how is it made?

☐ Marking in cast
☐ Laser
☐ Ink jet
☐ Warm-pressing
☐ Other Indicate below:

Part	Other marking (type)	Statement of reasons

[13] For instance easiness to separate (not glueing and welding) different types of materials, no special tools are necessary for dismounting etc.
[14] For instance in the directions for use, separate document etc.
[15] For instance directions for dismounting, declaration of contents etc.

E.6 Can you in the present situation, or are you planning to, take used products back for material recycling if Telia so desires?

☐ Yes: __________ % of the product we can take back in the present situation.
☐ No: but we will be able to take ____ % of the products back in year: ____
☐ No

F

MATERIALS/SUBSTANCES

F.1 Does the product contain any substance listed by the Swedish National Chemicals Inspectorate in the List of restricted chemical substances in Sweden, the latest updating?

☐ No
☐ Don´t know
☐ Yes: specify substances below:

Chemical symbol	Substance	Statement of reasons	Product/subproduct

F.2 Is flame retarding agent used in any form in the product?

☐ No
☐ Yes If yes, specify product, flame retarding agent (substance) and Reason :

Part	Flame retarding agent/substance	Statement of reasons

F.3 Are alloys of metals used in the product?

☐ No
☐ Yes: If yes, specify part and reason :

Part	Statement of reasons

F.3.a If alloyed metals are used, specify which metal alloys that are used, where they can be found (in the product), and the total weight.

Alloy of metals	Part	Weight (kg)

F.4 Does PVC constitute a part in the product (and in cable)?

☐ No
☐ Yes If yes, answer remaining questions under F.4 :

F.4.a If PVC is used, specify in which part it constitutes a part, type of material and reason !

Part	Type (cable, socket etc.)	Statement of reasons

F.4.b Does PVC contain chloro alkanes C_{10-13}, or organic tin compounds?

☐ No
☐ Yes

F.4.c Specify below which softening agents and stabilizers that constitute parts in the used PVC-product.

Part	Type (cable, socket etc.)	Stabilizer (chemical symbol etc)

Part	Type (cable, socket etc.)	Softening agent (chemical symbol etc)

F.5 Specify per product in respective category[16] up to 98 % of total weigth and volume the materials/combination of materials which constitutes the largest part. Racks/Mechanics and Packings are specified under respective point.

Category	Included materials / combination of materials (chemical symbol or the like)	Weight %	Weight (kg)	Volume	Made of recycled material? Yes (x)	Can be recycled with today´s technology Yes (x)
Total		>98%		>98%		
Total		>98%		>98%		
Total		>98%		>98%		
Total		>98%		>98%		

G

[16] Suggestions for suitable classification can for instance for an electronic product be as follows: Case/chassis, circuit cards/electronic components, cables and contacts/connections.

PACKING

G.1 Is the company connected to a system for re-use or recycling of material of the packing?

☐ Yes: the company is connected to a system for recycling of material. Specify below:
☐ Yes: the company is connected to a system for re-use. Specify below:
☐ Yes: the company is connected to the REPA-register.
☐ No: no packing is used.
☐ No

System	Description	Product

G.2 Specify the included materials/combinations of materials per resp. category.

Category	Included materials/ combination of materials.	Weight %	Weight (kg)	Made of recycled material? Yes (x)	Can be recycled with today´s technology Yes (x)
Transport packing					
-"-					
-"-					
Filling up packing					
-"-					
-"-					
Customer packing					
-"-					
-"-					
Filling up packing					
-"-					
-"-					

H

ELECTRONIC CONSTRUCTION

Design

H.1 Are the components mounted on both sides of the printed board assembly ? (This in order to reduce volume and power consumption).

☐ Yes
☐ No If no, specify part and reason :

Part	Statement of reasons

H.2 Which wiring technology is used for the components (in the construction)?

☐ Flip-chip, wirebonding or TAB
☐ Surface mounting
☐ Hole mounting
☐ Other Specify below:

Wiring technology	Description

H.3 Is the equipment (if it is possible with regard to the technical demands, access times etc) constructed with automatic power reduction, so called "power down"?

☐ Yes
☐ Not relevant
☐ No If no, specify product and reason :

Part	Statement of reasons

H.3.a Specify the energy consumption (nominal/reduced).

Part	Criterion for change	Energy consumption (nominal)	Energy consumption (reduced)

H.4 If cooling is used (fans, separate cooling systems etc), is it temperature/thermostat controlled?

☐ Not relevant No cooling or passive cooling is used.
☐ Yes
☐ No If no, specify part and reason :

Part	Statement of reasons

H.5 If voltage transformation is needed, is it made with so called switched voltage transformation, alternatively even more efficient transformation technology?

☐ Yes
☐ No If no, specify part and reason:

Part	Statement of reasons

H.6 Are batteries, in addition to the normal power supply, mounted on or in direct connection to the printed board assembly ?
(Here is related to batteries with mercury, silver oxide or such batteries which have been mounted on the printed board assembly or in direct connection to it. The aim with these batteries often is to back up the memory at a power failure or the like.)

☐ No
☐ Yes If yes, please answer H.6.a.

H.6.a If separate batteries as above are utilized, specify location, type of battery and, if possible, reason for using the solution with printed board mounted batteries.

Part	Statement of reasons /type of battery

H.7 Is the mounting easy to separate at dismounting ?
(For instance easiness to separate different types of materials, no special tools are needed for dismounting, cables between the cards can be separated without using cutting nippers etc).

☐ Yes: for ________ % of the product such measures have been taken at construction. Specify measure below

Part	Measure

☐ No for ________ % of the product such measures have NOT been taken at construction. Specify reason below

Part	Statement of reasons

H.8 Is glueing/welding of different materials used in the product?

☐ No
☐ Yes If yes, specify part and reason:

Part	Statement of reasons

H.9 Is the product built up of smaller modules which easily can be separated from each other ?

☐ Yes
☐ No If no, specify part and reason

Part	Statement of reasons

H.10 Does the product contain paper phenol cards?

☐ No
☐ Yes If yes, specify part and reason :

Part	Reason

H.11 Are components which may need to be changed mounted in sockets?

☐ Yes
☐ Partially If partially, specify part and reason
☐ No If no, specify part and reason :

Part	Statement of reasons

H.12 Are the printed board assemblies laquered/varnished?

☐ No
☐ Yes If yes, specify part and reason

Part	Statement of reasons

H.13 Are plastic parts covered with colour or metallized?

☐ No
☐ Partially If partially, specify part and reason
☐ Yes If yes, specify part and reason:

Part	Statement of reasons

H.14 Are metal parts, cables or printed board assemblies moulded in plastic?

☐ No
☐ Partially If partially, specify part and reason
☐ Yes If yes, specify part and reason

Part	Statement of reasons

I

BATTERIES

I.1 Does the product contain batteries?

☐ No
☐ Yes: If yes, answer questions I.2-I.4 below.

I.2 Are the batteries in the product harmful[17] to the environment?

☐ No
☐ Yes:

I.3 Are there disposable batteries in the product?

☐ No
☐ Yes: If yes, specify.

Type of battery	(e.g Alkaline)	Statement of reasons

I.4 Are there rechargeable batteries in the product ?

☐ No
☐ Yes: If yes, specify below.

Type of battery (button cell etc)	Substance (e.g NiCd)	Statement of reasons

J

[17] Batteries are classified as harmful to the environment if they contain more than 0.025% of mercury and cadmium, or more than 0,4% lead.

RACKS/CABINETS/MECHANICAL STRUCTURE/MASTS

The field shall be accounted for product by product; rack mechanics, station mechanics and masts. For each product, declaration shall be made separately.

Racks/mechanics:

With rack mechanics is related to the protection equipment (rack, cabinet or cover) which makes it possible to mount the technical equipment in this unit. As rack mechanics are also regarded different equipment for connection- and distribution fields. Electronics, cables, and/or connection devices being part of rack mechanics shall be related to respective subject field.

Station mechanics:

With station mechanics is related to the mechanics which holds the station´s common cables and electronics, such as troughs with accessories, beams of different kinds with accessories etc.

Masts:

With masts is related to the mechanical equipment which is needed to hold antennas, radio links (outdoor mounting). Here also are included stay wires and concrete bases, if any.

J.1 Does there exist any kind of coating, paint, corrosion preventing agent or the like?

☐ No
☐ Yes If yes, specify part/coating and motive.

Part	Substance (chemical symbol)	Statement of reasons

J.2 Do there exist fastening parts for the product, such as screws, nuts, washers, clips, bands, holders, glue or the like?

☐ No
☐ Yes: If yes, specify material and amount, and motive for included fastening parts.

Fastening part	Material (chemical symbol)	Total weight	Statement of reasons

J.3 Specify per product in respective category[18] up to 98% of the total weigth and volume of respective category the materials/combinations of materials constituting totally the most part:

Category	Included Materials / combination of materials (chemcial symbol or the like)	Weight %	Weight (kg)	Volume	Made of recycled material? Yes (x)	Can be recycled with today´s technology Yes (x)
		>98%		>98%		

[18] Suggestions for suitable classification can for mechanics be for instance the following: Cover, cabinet, rack, station mechanics and masts. To that additions can be made for fastening parts, screws or the like.

K PAPER PRODUCTS

Printed matter: Start at question K.1.
Other paper products: Start at question K.2.

K.1 Is the printing office licensed for Eco-labelling of printed matter?

☐ Yes: specify below voluntary Eco-labelling[19]:
☐ No but application for a license has been handed in/is under preparation. Specify planned date of application below and answer questions K.2-K.6.
☐ No Answer questions K.2-K.6.

Eco-labelling	Registration number	Date

K.2 Is the product Eco-labelled with any voluntary Eco-labelling?

☐ Yes: Specify below voluntary Eco-labelling[20].
☐ No Answer questions K.3-K.6.

Product related to	Eco-labelling	Registration number	Intr. date

K.3 Is the product made of chlorine bleached pulp?

☐ No The product is not bleached
☐ No Chlorine free (TCF) bleaching agent has been used
☐ Yes: If yes, specify method of treatment

Method of treatment, chlorine bleached paper

K.4 Does the paper product contain recycled fibres?

☐ Yes If yes, see below
☐ No

Specify type of recycled fibres/ respective its part in %

K.5 Is the product printed with colours which contain heavy metals?

☐ No
☐ Yes: Specify below

Type of colour	Specification

K.6 Which colours are used at the printing of the product?

☐ Water based colours.
☐ Colours based on vegetable oils.
☐ Colours based on other oil.

---

[19] For instance SIS Eco-labelling (the Swan), the EU-flower, Blauer Umweltengel, Bra miljöval etc.
[20] For instance SIS Eco-labelling (the Swan), the EU-flower, Blauer Umweltengel, Bra miljöval etc.

Type of colour	Specification

L

MACHINE CONTRACTORS

L.1 Which Eco-class for diesel fuel does exist within your company?

- ☐ Eco-class 1
- ☐ Eco-class 2
- ☐ Eco-class 3

L.2 Which Eco-class for petrol does exist within your company ?

- ☐ Eco-class 1
- ☐ Eco-class 2
- ☐ Eco-class 3

L.3 Which Eco-class for vehicles > 3,5 tons does exist within your company?

- ☐ Eco-class 2
- ☐ Eco-class 3

L.4 Which Eco-class for working machines does exist within your company?

- ☐ Eco-class 1
- ☐ Eco-class 2

L.5 Do there exist vehicles/working machines within your company which are adapted to alternative, renewable fuels?

- ☐ Yes Specify below
- ☐ No

Type of working machine	Fuel	Use (in %)

L.6 Do there exist within your company electrically powered engines (alternative to fossil powered) intended to be used in densely populated areas?

- ☐ Yes Specify below
- ☐ No

Type of working machine	Type of battery	Use (in %)

L.7 Are Eco-labelled tyres used within your company?

- ☐ Yes Specify below
- ☐ No

Type of tyre	Eco-labelling	Use (in %)	Type of vehicle

L.8 Are Eco-labelled lubricating oils, hydraulic oils or the like used within your company?

- ☐ Yes Specify below
- ☐ No

Type of lubricating oil	Eco-labelling	Use (in %)	Type of vehicle

L.9 Will harmful waste products arise within your activity, and do you have routines to manage this?

☐ Yes Specify below
☐ No

Type of waste products	Routine

1. Is a Material Safety Data Sheet (MSDS) required for your product(s)? No

   If "yes", please submit a copy of all applicable MSDSs.

2. If the answer is "no" and you are selected as an approved BellSouth Supplier, will you agree that, if you make any subsequent changes to your product which would require an MSDS, you will supply the appropriate MSDS(s) to the BellSouth within thirty (30) days of the change to the product? Yes

3. Will you agree to send any amended MSDS within thirty (30) days of any such amendments? Yes

4. Does the product contain any Extremely Hazardous Substances as defined in SARA Title III? If so, please list. No

5. Is a CERCLA Reportable Quantity (RQ) applicable to the product? If so, please provide. No

6. What (if any) environmentally sensitive chemicals are used in your manufacturing process? Isopropyl Alcohol, Solder Containing lead.

7. What (if any) environmentally sensitive emissions are used in your manufacturing process? VOCs

8. What (if any) environmentally sensitive waste is generated in your manufacturing process? Isopropyl Alcohol and Solder Dross Containing lead.

9. Will normal use of the product result in generation of a waste stream? Please explain. No

10. What is the shelf life of the product? There is not a defined shelf life.

11. Will the product be a hazardous waste, as defined in 40 CFR 261, when/if disposed of?
    No. Printed Circuit Boards contain heavy metals. If treated under the EPA Precious Metals Exemption for metals reclaim, they are not considered a hazardous waste.

12. List the EPA hazardous waste codes which would apply if the unused or expired product were disposed of: (example: D008, U226)
    N/A if metals are recycled

13. List the EPA hazardous waste codes which would apply if the spent product were disposed of: (example: D008, F001). N/A

14. Will the waste be subject to land ban restrictions? N/A

15. Are there other special disposal requirements or precautions?

16. Is the waste recyclable? Yes

17. Can you offer recommendations for disposal/recycling, options for return to supplier?
    Possibly, please contact Everett Foote, Sr. Manager, Product Lifecycle Management

18. Is the product a DOT hazardous material? No

Supplier Questionnaire

Cable & Wireless

Part 4: Health, safety and environment

Please provide:

1.1 Your Company Health and Safety Policy document.

1.2 Your Company Environmental Policy document, together with a short statement setting out:

- How long the policy has been in place
- How is it being communicated to employees
- The main environmental effects of your company's activities
- How you monitor progress with policy implementation.

1.3 If no written policy exists, then a statement setting out what you consider to be the main effects of your company's activities on the environment and how these effects are being managed.

1.4 Details of written procedures in operation within your company to control any of the following:

- Pollution incidents, spillages or leaks
- Labelling, storage and disposal of "special wastes"
- Use of materials, e.g. paper
- Use of resources, e.g. energy consumption.

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1.5 The names and professional qualifications of employees or consultants who advise you on health, safety and environment matters.

1.6 Data on the number of fatalities, serious and minor injuries and cases of ill health resulting from accidents or conditions in the workplace within your company, for each of the last three years.

1.7 Details of any prosecution, statutory enforcement or civil action dealing with health, safety or environmental issues, which has been initiated against your company in the last three years, and also of any remedial action which has been taken as a result.

Pat
[illegible]

1.8 Details of your procedures for establishing the health, safety and environmental standards of your own suppliers of goods and services, including any questionnaires which are used in these procedures.

1.9 Evidence to demonstrate the capability of your products to meet relevant health, safety and environmental standards, and of any research or testing carried out in developing this capability.

1.10 Details of your safety training programme for holders of specialist jobs which involve particular risks, general employees, supervisors and managers.

1.11 Evidence of your capability to prepare risk assessments, safety plans and method statements, as appropriate to your business activity, specifically including procedures for these tasks and for their allocation to competent advisers, with relevant examples of such work.

1.12 The results of the most recent health, safety and environmental audits carried out on your organisation within the last three years.

End of Part 4

Mitsubishi Electric Co Ltd

Environmental Survey Date: June 17, 1997

	Question	Answer (circle)	
ISO certification	1. Has your company obtained ISO 14001 certification? -at 6 manufacturing facilities, not company-wide yet	(1) Yes	(2) No
	If yes, please write your certificate number:	Date: 96-97	
	If you answered Yes above, the survey is complete. If No, please continue with the following questions.		
General	2. Have you formed any environmental management organizations such as a strategy committee?	(1) Yes	(2) No
	3. Has your company been officially cautioned or penalized over the past five years? We have received notices of violation, no penalties.	(1) Yes	(2) No
	4. Do you educate your employees on environmental protection matters?	(1) Yes	(2) No
Conserving energy	5. Do you carry out measures to promote energy saving?	(1) Yes	(2) No
	If yes, please describe the activities in detail. Motion detectors for lighting, computer controlled heating/cooling, heat reflective roofing, window glazing, power saving copiers/computers, printers, close attentio[n] to mainte[nance] of mach[ines]		
Preventing pollution	6. Does your company strictly observe the restrictions imposed by environment-related laws? vary by jurisdiction	(1) Yes	(2) No
	Check (v) the applicable laws and indicate the main restrictions in [ ]. V Air pollution laws [limits on concentrations/daily loadings of toxics, VOCs, metals] V Water quality protection laws [same as above (air)] V Anti-noise laws [not usually an issue with our operations] V Noxious odor laws [no discernible odor at property boundary] V Soil pollution laws [no dumping of contaminants or leakage of underground storage tanks] __ Vibration restriction laws [ ] __ Ground subsidence laws [ ] __ Other [ ]		
Disposing of wastes	7. Does your company take active measures to reduce wastes and to recycle resources?	(1) Yes	(2) No

6.8.3 Describe the possibilities of recycling materials from scrapped equipment.

6.8.4 The supplier should be able to take back the equipment quoted for reuse, recycling, or scrapping in an environmentally acceptable way, during a period of at least 10 years after procurement. Describe the terms for such obligations and whether they will be implemented by the supplier himself, by a subcontractor, or in another way.

6.9 Analog standard telephones

6.9.1 The supplier should offer analog standard telephones that are approved by PTS according to SS 63 63 41.

6.10 System telephones

6.10.1 Describe the technology, functions and other characteristics of the system-unique telephones (system telephones) that are offered together with the PBX.

6.10.2 Describe especially the requirements made on the premises network when connecting up the system telephones. It should be possible to locate the system telephones at a cable length of at least 1 km from the PBX, assuming that the premises network complies with Swedish standard SS 63 63 50.

6.10.3 The system telephones should be powered in all parts from a central power supply.

6.11 ISDN telephones

6.11.1 The supplier should offer approved ISDN telephones (intended for IS_0 interface).

6.11.2 Describe the characteristics of the ISDN telephones quoted, as regards technology, functions and other characteristics.

6.11.3 The ISDN telephones should be powered in all parts by a central power supply.

6.12 Cordless telephones

6.12.1 As a complement to the PBX, the supplier / A: should / B: shall / C: shall / be able to offer a cellular system for cordless telephony.

Appendix IV.

ECMA Technical Report TR70

ECMA

Standardizing Information and Communication Systems

5 Information to customers

The following information should be included in a suppliers declaration, as far as these are relevant to the specific product categories.

5.1 Product information/description

The following should be provided where applicable. This list should include, but not be limited to:

- type of product;
- brand name;
- model number;
- supplier/manufacturer;
- weight and dimensional characteristics (kg and cm);
- statement that mechanical plastic parts heavier than 25 g (50 g?) are marked according to ISO 11469.

5.2 Upgradability/Extendibility

The design considerations of the basic unit, which allow the product features and product capability/profile to be enhanced, should be listed.

The service warranty/policy offered by the manufacturer should be listed.

5.3 Extension of product lifetime

The following items should be declared:

- availability of spare parts for the product from the time of purchase in years
- availability of service for the product from the time of purchase in years

If spare part and service availability is restricted, restrictions should be listed.

5.4 Energy Consumption

All relevant products and equipment should list the energy consumption in watts appropriate to the product type.

Some examples are:

TVs	Monitors	Computers	Copiers	Printers
On Standby passive Off	Operational Standby Off	Sleep Off	Operational Standby Off	Stand by Off

Measurement should be performed using the procedure specified by the EPA Energy Star program for appropriate products, including the methods for operational modes. For TV sets publication IEC 107-1 should be used.

If a product allows multiple levels of energy saving modes, these should be listed in the product declaration.

Products following any other guidelines can list this information with the appropriate measurement in the appropriate section(s) of the product declaration (annex A). The measurement protocols associated with these guidelines should be followed.

5.5 Electromagnetic emissions

5.5.1 ELF/VLF electromagnetic emissions

Public perception and increased requests from customers related to magnetic field emissions, which emanate from monitors have led to the Swedish guideline MPR II - 1990:8 for Band I and II ranges in both electric and magnetic fields. Alternatively, the Swedish standard SS 436 14 90 (so called MR III) may be adopted.

A declaration should be made as appropriate to the relevant standard and referenced in annex A.

5.5.2 Radio frequency emissions

The international standard for radio frequency emissions from information technology equipment respectively consumer electronics equipment will be met as follows, taking into account special marked requirements and conditions:

Information and communication technology:
CISPR22 (EN 55022)
CISPR24 (EN 55024)

Consumer electronics equipment:
CISPR13 (EN 55013)
CISPR20 (EN 55020)

Both Groups:
IEC61000-3-2 (EN61000-3-2)
IEC61000-3-3 (EN61000-3-3)

the mentioned EN standards are effectively legal requirements in the European Union.

The legislation and relevant standards, shall be recorded in the suppliers declaration as referenced in annex A.

5.6 Physical emission

5.6.1 Acoustical Noise

Noise emission information for relevant products should be provided as **declared sound power levels LwAd** and **sound pressure levels LpAm** for the operational and power saving modes.

Measurements should be made according to standards ECMA-74 (ISO 7779:1988) and ECMA-109 (ISO 9296:1988).

If the product (e.g. Monitors or TV-Sets) is emitting high frequency noise, which is not covered by ISO 7779 and ISO 9296, additional information should be reported regarding the high frequency noise.

The measurements of the high frequency noise should be performed, according to ECMA-108 (ISO 9295:1988). The **High Frequency sound power level Lw** in dB and **the frequency f of the tone** in Hz should be reported for the operational mode and the applicable power saving modes.

5.7 Chemical emissions

5.7.1 Ozone

The concentration that a user is exposed to in the breathing zone should be below the Threshold Limit Values set by IEC 950 (EN 60950).

ECMA

Standardizing Information and Communication Systems

Value is to be determined in full operation of the product. Measurement in terms of mg/m^3 is to be conducted according to procedures outlined in ASTM D5116/90.

5.7.2 Dust

Values should be determined for full operation of the product. Measurement in terms of mg/m^3 is to be conducted according to procedures outlined for copiers in RAL-UZ 62.

5.7.3 Styrene

Measurement in terms of mg/m^3 is to be conducted according to procedures outlined for copiers in RAL-UZ 62.

5.8 Materials

A declaration should be made for at least the following substances (covered by legislation and/or voluntary initiatives) that they are not present in concentrations exceeding the natural background levels:

- asbestos;
- cadmium (in plastic materials, packaging and inks);
- CFC and/or HCFC;
- chloroparaffins with chain length 10-13 C atoms, chlorination greater than 50% contained in mechanical plastic parts heavier than 25 g;
- lead contained in mechanical plastic parts heavier than 25g;
- mercury;
- PCB or PCT;
- polybrominated biphenyls, their oxides and their ethers contained in mechanical plastic parts heavier than 25 g.

The presence of the listed substances which do exceed natural background levels should be declared.

Determination of the material composition should be conducted in accordance with accepted industry practices.

5.8.1 Additional information

To meet the requirements of users who wish to ensure that products can be easily dealt with at end of life the following disassembly information should be included:

5.8.1.1 Product information/description

Technical specifications regarding the product may be provided. In addition, the following information should also be included:

- type of product
- brand name
- model number
- identification/serial number, year of production or any other point of identification.

Information on battery disposal should also be included.

5.8.1.2 Materials contained in the product

Information should be included on the major material items that are included within the product, e.g.,

- casings and covers are manufactured from ABS plastic;

ECMA

Standardizing Information and Communication Systems

- fan and motor contain aluminium;
- cables are enclosed in PVC;
- type of solder used in the printed circuit boards;
- keyboards are manufactured from ...;
- overall number and type of plastics included in the product.

This information will ensure that the supply chain (including the distributors) has a cleared picture of what material streams will result from recycling.

5.8.1.3 Ease of disassembly

The manufacturer and/or systems integrator should list any actions/initiatives that have been included in the design of the product to make disassembly and upgradability easier at end of life. Take-back information should also be included.

For example:

- outline of re-manufacturing process (if one has been established)
- principle disassembly process
- inclusion of snap-fit assembly
- number of screws used
- recyclability of major materials, e.g., the ABS plastics and the ferrous metals in this product are recyclable and there is a market for the resulting recyclate.

This information will help both end users and third parties in the supply chain decide upon the environmental performance indicators concerning there-use, disassembly and recycling of the product at end of life.

5.9 Batteries

The following items should be declared:

- the type of battery (e.g. nickel-cadmium) used;
- batteries used in the product are in conformance with the EU Directive 91/157/EEC ('hazardous substances') and EU Directive 93/86/EEC ('marking requirements');
- instructional information concerning the handling of the batteries in the product including proper installation replacement and disposal is given in the product documentation

5.10 Packaging

Type and weight of packaging materials should be declared.

Marking of packaging should be declared.

Details of any packaging audit/reduction should be declared.

Any manufacturer' initiated take-back schemes for used packaging should also be detailed.

National guidelines and/or regulations apply. These may include disposal and/or recycling instructions, types of materials permitted, materials identification, etc. Local ordinances may also apply.

5.11 Documentation (user manuals)

Post-consumer recycled content and paper bleaching method should be declared.

Appendix V.

Gap Analysis Questions

Code	Question
A	**Eco-Management system**
A101	Eco-management system (standard accredited)
A102	Own management system
A103	Contractors EMS y/n
A104	Plans for EMS system
A105	Does EMS concentrate on hazard prevention with documentation on processes, products, packaging
A106	Details of written procedures to control: pollution incidents, labelling/storage of special wastes/ material usa, resource use
B	**Policy**
B101	Any written eco-policy
B102	Any written eco-goals
B103	Written action programmes to achieve goals
B104	Public reporting
B105	Dedicated employees for eco-questions
B106	Eco-training for employees
B107	Eco-revisions?
B108	Eco-demands on contractors beyond demands of regulation
B109	Is your policy supported by an Environmental Impacts or Risk Assessment with respect to your company's activities.
B110	Senior manager with direct responsibility?
C	**Product**
C1	**Eco-labelling**
C102	Marked with voluntary eco-label
C2	**Manufacturing**
C202	Does activity require regulatory permission/licensing
C203	Any substances used in manufacture listed in a specified list of restricted chemical substances
C204	Working to limit the existence of these substances
C205	Working to limit the existence of substances such as effluents, solvents etc
C206	Are detergents/degreasing compounds used in manufacture
C207	Member of staff responsible for chemicals on site
C208	Corporate/site plans for emergencies
C209	Does company use ozone depleting substances (plans to eliminate)
C210	Adequate controls to prevent catastrophic releases inc

	fires/explosions?
C211	Storage tanks on site? Describe.
C212	Evidence of past on-site contamination?
C213	Test/monitoring programme on environmental control?
C214	Public complaints filed?
C215	Environmentally sensitive wastes from manufacturing
C216	List five most significant environmental burdens and reasons why
C217	A register of environmental legislation and /or effects
C218	A formal system to monitor environmental non-compliance with legislation and corporate environmental policy
C3	**Use**
C301	Emissions of any substance listed in a specified list of chemical substances
C302	Use and maintenance cause known env and health hazards
C303	Is product less polluting during its use than competing products
C304	Is product easy to maintain
C305	Is product easy to repair (disassemble, modular etc..)
C306	Can the product be easily upgraded
C307	Can the material data sheet be supplied with the product
C308	Flammability rating
C309	Specified limits stated for certain physical and chemical emissions
C310	Specify energy consumption
C311	Specify limits for electromagnetic emissions
C4	**Waste products**
C401	Company connected to a re-use/recycling system
C402	Any measures taken to facilitate recycling at construction
C403	Any info available to facilitate recycling
C404	Plastic parts marked according to ISO 11469
C405	How is marking of product made
C406	Is product takeback available or being considered
C407	Targets for waste production? (policy)
C408	Waste policy prioritise prevention and minimisation?
C409	Are all waste streams measured - quantities of waste?
C410	% of site hazardous waste sent to landfill, incineration, recycling, treatment
C412	If product is disposed of in sewage treatment system will it biodegrade
C413	Provision of a recycling diagram for all parts
C414	Takeback guaranteed
C415	Units containing components with substances hazardous to health or environment must be marked
C416	Describe the possibilities of recycling materials from scrapped equipment
C417	Will the product be a hazardous waste when/if disposed of? (qualified)

C418	Is the product a DOT hazardous material
C419	Does the polymer liberate toxic substances when heated
C5	**Materials**
C501	Contain any substances listed in a specified list of chemical substances
C502	Flame retardent
C503	Metal alloys (what, where, weight)
C504	PVC (product and cable, which parts, why)
C506	Does PVC contain chloro alkanes or organic tin compounds
C507	State softening agents and stabilizers used in PVC
C508	Specify by weight and volume the materials / combination of materials which form the product
C509	Does the product contain lead (solder) where, considered substitutes?
C510	Does the product contain berylium oxide, where, considered substitutes?
C511	Does the product contain bromine, where, considered substitutes?
C512	Use and storage of the following: lead, chromium, mercury, manganese, Halon fire ext system, PCBs, ODS.
C513	Highlight discolored soil/vegetation, waste water discharge to trenches/ditches etc, correct storage of chemicals/hazardous substances
C514	Does maintenance and up-keep entail the use of substances listed in a specified list of chemical substances
C515	Does the product contain post-consumer recycled materials?
C516	Is an MSDS sheet required for the product
C517	Does the product contain ozone depleting substances
C518	Specify substances to avoid / recyclable value
C519	Sign a declaration
C520	Are specific precautions required at normal handling of the product and/or packaging.
C521	Are toxicological data available about the basic polymer(s) and/or its monomer(s).
C6	**Packaging**
C601	Company connected to a system for re-use / recycling of packaging
C602	Specify materials in all packaging by weight/percentage
C603	Company use or handle >50 tonnes of packaging?
C604	Targets for reduction / minimisation
C605	Employee responsibility?
C606	Programme for proper labelling/packaging, shipment of hazardous materials?
C607	Does the packaging material have post-consumer recycled content?

C608	Package details - recyclable, toxic, degradable, disposal method
C7	**Electronic construction**
C701	Components mounted on both sides of PCB (space/p-consumption)
C702	Specify the wiring technology for components (surface/hole etc)
C703	Can equipment "power down" if possible
C704	Specify energy consumption - different modes
C705	Cooling systems - are they temp / thermostat controlled
C706	Voltage transformation if needed - switched or alternative?
C707	Are batteries mounted on or connected to PCB - location, type, reason
C708	Is the PCB assembly easy to disassemble
C709	Is glueing/welding of materials used in the product
C710	Is the product built up of modules - easy to separate
C711	Does product contain paper phenol cards
C712	Are changeable components mounted in sockets
C713	Are PCBs laquered/varnished
C714	Are plastic parts painted or metallised
C715	Are metal parts, cables or printed board assemblies encased in plastic.
C8	**Batteries**
C801	Does the product contain batteries
C802	Are they harmful to the environment (contain 0.025% mercury and cadmium or >0.4% lead
C803	Are there disposable batteries in product
C804	Are there rechargeable batteries in product
C805	Batteries conform to EU regulations and instructions for handling/replacement/disposal
C 9	**Mechanical structure**
C901	Coating, paint, corrosion preventing agent - specify
C902	State material and amount of fastening parts - screws, nuts, washers, clips, bands, holders, glues etc
C903	Specify by weight and volume the materials / combination of materials which form the product
C10	**Design guidelines**
C1001	Are environmental considerations formally included in the design phase
C1002	Is product designed to minimise mass/volume, use consistent materials?
C1003	Is product re-usable or does it include re-usable parts

D	**Paper products**
D101	Is printing office licensed for eco-labelling of printed matter
D102	Is paper product eco-labelled
D103	Is product made of chlorine bleached pulp
D104	Does the paper product contain recycled fibres
D105	Is product printed with colours which contain heavy metals
D106	Which colours are used at the printing of the product (water-based, oil based etc..
E	**Machine contractors**
E101	Which eco-class for diesel fuel exists in the company
E102	Which eco-class for petrol fuel exists in the company
E103	Which eco-class for vehicles > 3.5 tons exists within the company
E104	Which eco-class for working machines exists within the company
E105	Are there any vehicles/machines adapted to alternative, renewable fuels
E106	Are there electrically powered engines in the company designed for use in densely populated areas
E107	Are eco-labelled tyres used in the company
E108	Are eco-labelled lubricating oils, hydraulic oils used within the company
F	**Supplier assesssement**
F101	Does company assess its larger component suppliers/ intending to
F102	How are assessements carried out
F103	Raising awareness amongst suppliers?
G	**Site Survey**
G101	Survey questions - activities, topography, nearby water, property
H	**Regulatory compliance**
H101	Has your company had any action taken against it by any environmental regulatory agency?
H102	The tenderer shall specify standards, pre-standards and EU Directives concerning environmental matters which the equipment supports
H103	Does company observe restrictions imposed by regulations (environment)

Appendix VI.

Gap Analysis Spreadsheet

Customer	Nortel

Appendix VII.

Nortel Networks Environmental Toolkit Questionnaire

Appendix VII Nortel Environmental Toolkit Questionnaire

• **Expected Return Date of questionnaire**	
• **Company Name**	
• **Address (Head Office)**	
• **Main products supplied to Nortel**	
• **Name of Respondent**	
• **Position within the Company**	
• **Internet E-mail address (optional)**	
• **Telephone number**	
• **Facsimile number**	
• **Signature**	

Issue 1

A. Environmental Management System

1. Does the Company have a Corporate environmental policy statement?

{yes} {no}

2. Do **all** the production site's have a formal environmental management system?

{yes} {no}

3. Have **all** the production site environmental management systems been accredited with a national or international standard?

{yes} if yes then go to A5 {no}

4. If no, then are there plans to move towards an accredited scheme for all production sites before 2000?

{yes} {no} {n/a}

5. Is there a Board member with direct responsibility for environmental issues/legislative compliance?

{yes} {no}

Indicate which elements are present and operational within the company environmental management system:

Element	Response
6. A Corporate commitment to continuous environmental improvement	{yes} {no}
7. Corporate quantitative targets and objectives for environmental improvement e.g. waste reduction, energy efficiency, water use	{yes} {no}
8. A formal system to monitor environmental non-compliance with environmental legislation and Corporate environmental policy,	{yes} {no}
9. A register of environmental legislation and/or effects,	{yes} {no}
10. A regular Corporate review of the company's environmental performance	{yes} {no}

11. Does the company undertake regular environmental audits of **all** it's manufacturing sites?

{yes} {no}

B. Hazardous Materials

1. Does any of the production sites use or store chemicals that could cause business interruption e.g. high pressured gases, toxic chemicals, flammable chemicals?

{yes} {no}, if no then go to B3

2. Is their a member of staff responsible for storage, handling and use of these chemicals on **each** Production site e.g. an EHS or Environmental Site Manager?

{yes} {no} {n/a}

3. Are there site plans or Corporate level instructions/regulations for emergency situations where chemicals may be in danger of causing environmental damage and/or business interruption?

{yes} {no}

4. Does the company use ozone depleting substances in any of it's production processes?

{yes} {no}, if no then go to B6

5. Are there plans or Corporate objectives to eliminate the use of these chemicals within the processes?

{yes} {no} {n/a}

6. Does the company use any chemicals which are scheduled for restricted use e.g. methyl bromide and HCFC's

{yes} {no}, if no then go to C1

7. And if so are there Corporate plans for their removal from the production process?

{yes} {no} {n/a}

C. Environmental Supplier Assessment

1. Has the company undertaken an environmental assessment of it's larger component suppliers in the last two years?

{yes} {no}, if no then go to C3

2. If there is no supplier assessment system in place, then is the company intending to introduce a supplier assessment procedure before 2000?

{yes} {no} {n/a}

How are these supplier assessments undertaken at present:

Elements	Response
3. Environmental audits	{yes} {no}
4. Quality audits including environmental considerations	{yes} {no}
5. Environmental questionnaires	{yes} {no}

6. Is the company involved in raising environmental awareness among suppliers e.g. the organisation of seminars, distribution of information?.

{yes} {no}

D. Packaging

1. Does the company use or handle over 50 tonnes of packaging per annum ?

{yes} {no}, if n then go to E1

2. Do you have targets and objectives in position for the reduction and/or minimisation of packaging use?

{yes} {no} {n/a}

3. Do certain employees within the company have specific responsibilities to meet these targets and objectives?

{yes} {no} {n/a}

E. Waste control

1. Does the company's environmental policy include targets for waste reduction?

{yes} {no}

2. Does the company's waste policy prioritise waste prevention and minimisation over recycling and disposal?

{yes} {no}

3. Are there specific targets on all sites for the reduction and recycling of different types of waste e.g. energy, water and general waste.

{yes} {no}

4. Does the Company measure the quantities of waste being produced by all production lines and office units?

{yes} {no}

F. Product and product development

1. Is the company able to supply product composition information to Nortel to facilitate recycling of the product? e.g. what type/how much plastic is used in the product?

{yes} {no}

2. Is the company able of supplying information about the hazardous material content (e.g. lead, cadmium) in the product/component to Nortel?

{yes} {no}

2. Are environmental considerations such as disassembly features, reduction of hazardous materials in the product, formally included within the design phase? (e.g. through Corporate standards/instructions).

{yes} {no} {n/a, no designs undertaken}

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

Please return the completed item to:

Nortel Supply Management
Northern Telecom Plc.,
London Road,
Harlow,
Essex. CM17 9NA

Appendix VIII.

Supplier Pilot Documents

Harlow Laboratories
London Road
Harlow
Essex CM17 9NA
United Kingdom

Tel: +44 (0) 1279 429531
Fax: +44 (0) 1279 403009

NORTEL NETWORKS
How the world shares ideas.

12 October 1998

Dear Sir/Madam,

As part of Nortel's environmental performance improvement program research is continuously being conducted on a variety of environmental management tools and techniques. Within the Ecodesign and Technology department we are currently investigating how supply chain environmental data can be utilised within the corporation in terms of ISO 14001 compliance and continual improvement programmes. We are also looking to see how we can meet customer needs for company and product environmental information as well as improving our ecodesign processes.

We are running a program with Nortel key suppliers to trial three versions of a new supplier environmental appraisal and information request questionnaire.

The trial has two objectives:

- To evaluate the questionnaires in terms of ease of completion and understanding by the supplier; and
- to provide an assessment of the level of product environmental information suppliers can provide.

Each questionnaire includes a form (Form A1) which allows product specific information to be entered into a spreadsheet. Ultimately, a complete material composition list by percentage weight for each component supplied to Nortel will be required. Of prime importance, however, is a declaration of the presence of certain specified hazardous substances in each component, the use of specified substances in the manufacturing process, and the emission of the specified hazardous substances during use.

It is recognised that many components with individual part numbers are manufactured using the same techniques, raw materials and energy and the same waste streams are generated. Therefore material composition data on one component can be used for an entire "family" if deemed representative and could cover a multitude of supplier part numbers. The supplier is asked to specify which supplier part numbers the information they supply covers.

The questionnaires are provided in electronic format as Excel spreadsheets. Form A1 is included as a second sheet in each questionnaire Excel work file. For the purposes of the trial, only one of the A1 Forms need be completed in any one of the questionnaire files. Completion instructions are provided on each questionnaire and on Form A1.

In addition to the data requested in the questionnaire, the supplier is asked to:

- Comment on the ease of completion of the questionnaire in terms of an understanding of what was being asked and layout;
- rank the three versions from 1 (best) to 3 (worst); and

- comment on the ability of the supplier to provide environmental data on all products supplied to Nortel.

Nortel Networks is committed to working with suppliers in a combined effort to develop products with improving environmental performance. Your co-operation in this trial will contribute to this effort and another step towards sustainability.

Please e-mail the completed questionnaires and A1 Forms to:

cmead@nortel.com

or place on a floppy disk and post to:

Carl Mead
Environmental Research Engineer
Ecodesign and Technology

at the above postal address by

1 December 1998.

If you have any questions concerning the questionnaires do not hesitate in contacting me (direct telephone: +44 (0) 1279 405 213.

Yours faithfully,

Carl Mead.

		Yes	No	Comments
	New Nortel Networks Supplier Environmental Assessment Questionnaire Version 1			
	Confidentiality of Supplier's Information: The information requested and obtained from the supplier in support of this questionnaire and which is identified by the supplier as being of a sensitive or proprietary nature, shall remain confidential and shall not be disclosed to any party outside of Nortel and its Subsidiaries. Where a Non-Disclosure Agreement exists between the supplier and Nortel, then the terms of that agreement shall also apply.			
Name of Supplier:				
Address:				
	Please answer the following questions with yes or no answers by placing a cross in the respective cell. Explanations can be briefly stated in the comments column if necessary with brief evidence to support the answer. Please change the size of the answer area if necessary. Form A1 is a separate sheet (tab Form A1).			
	Part A - Company Environmental Performance			
1	**Environmental Policy**	Yes	No	Comments
1.1	Does the your company have an environmental policy supported by senior management?			
2	**Environmental Management System (EMS)**	Yes	No	Comments
2.1	Does your company have an EMS that is accredited to ISO 14001?			
	If the answer to question 2.1 is yes go to Part B, if the answer is no please answer questions 2.2 - 2.10			
2.2	Does your company have an EMS?			
2.3	Is your company seeking ISO 14001 accreditation?			
2.4	Does the management system track developments in environmental regulations and relevant legislation?			
2.5	Does the EMS include a waste managment plan?			
2.6	Does the EMS include a systematic approach to environmental improvement including the use of performance indicators?			
2.7	Does the company have a system in place for assessing the environmental performance of suppliers of products?			
2.8	Does the company have a system in place for assessing the environmental performance of suppliers of services?			
2.9	Does the company consider environmental impacts associated with its transport function, i.e. delivery of products?			
2.10	Has the company been prosecuted for environmental regulatory non-compliance?Details:			
	Part B Product Environmental Performance			
1	**Section 1 Ecolabelling**	Yes	No	Comments
1.1	Is the product marked with any voluntary eco-labelling?			
2	**Section 2 Manufacturing**			
2.1	Do the activities of your company require regulatory licensing?			
2.2	Are hazardous materials as listed in Form A1 used in the manufacturing of your products? Please complete appropriate section of Form A1.			
2.3	Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? Complete appropriate section of Form A1.			
3	**Section 3 Use**			
3.1	During the use of the product are any of the materials listed in Form A1 emitted? Complete appropriate section of Form A1.			
4	**Section 4 Eco-Design**			
4.1	Have any of the following eco-design strategies been used in the design process of the product?			
	Hazardous material avoidance (see section 5.2) in component structure, coatings.			
	Re-usability			
	Marking of plastics			
	Recycled material content			
	Recyclability			
	Thermal convection reduction			
	Disassembly			
	Packaging minimisation			
	Transportation packaging re-use (take-back)			
	Transportation packaging recycled material content			
	Avoidance of transportation packaging coatings and bleaches			
4.2	Does the company have or intend to have a formalised eco-design programme that is part of the product development process?			
5	**Section 5 Product Environmental Information**	Yes	No	Comments
	The answers to the following questions will provide Nortel with an indication of the supplier's ability to provide Nortel with detailed product environmental performance data. If the supplier answers yes to any of the questions, Nortel requests that they provide the appropriate data in electronic format if possible. It should be noted that Nortel will comply with all national hazardous material regulations, it will not use banned substances in its products and is seeking to phase out the presence of substances proven to cause a risk to human health or the environment.			
5.1	Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete component materials declaration in Form A1)			
5.2	If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are considered by Nortel to be those on the list in Form A1.(Please complete the hazardous material declaration in Form A1 for each component)			
5.3	Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel? (Specify the products and provide the data in electronic format if available:)			
5.4	Can the supplier provide guiding information on end-of-life options for the supplied products?			

	New Nortel Networks Supplier Environmental Assessment Questionnaire Version 2			
	Confidentiality of Supplier's Information: The information requested and obtained from the supplier in support of this questionnaire and which is identified by the supplier as being of a sensitive or proprietary nature, shall remain confidential and shall not be disclosed to any party outside of Nortel and its Subsidiaries. Where a Non-Disclosure Agreement exists between the supplier and Nortel, then the terms of that agreement shall also apply.			
Name of Supplier:				
Address:				
	Please answer the following questions with yes or no answers by placing a cross in the respective cell. Explanations can be briefly stated in the comments column if necessary with brief evidence to support the answer. Please change the size of the answer area if necessary. Form A1 is supplied as a separate document (tab Form A1 below).			
	Part A - Company Environmental Performance			
1	Environmental Policy	Yes	No	Comments
1.1	Does the your company have an environmental policy supported by senior management?			
2	Environmental Management System (EMS)	Yes	No	Comments
2.1	Does your company have an EMS that is accredited to ISO 14001?			
	If the answer to question 2.1 is yes go to Part B, if the answer is no please answer questions 2.2 - 2.9			
2.2	Does your company have an EMS?			
2.3	Is your company seeking ISO 14001 accreditation?			
2.4	Does the management system track developments in environmental regulations and relevant legislation?			
2.5	Does the EMS include a waste managment plan?			
2.6	Does the EMS include a systematic approach to environmental improvement including the use of performance indicators?			
2.7	Does the company have a system in place for assessing the environmental performance of suppliers?			
2.8	Does the company consider environmental impacts associated with its transport function, i.e. delivery of products?			
2.9	Has the company been prosecuted for environmental regulatory non-compliance?Details:			
	Part B Product Environmental Performance			
1	Section 1 Design	Yes	No	Comments
	The answers to the following questions will provide Nortel with an indication of the suppliers commitment to improving the environmental performance of their products.			
1.1	Does the company have a Design for Environment (DFE) programme in place that is a formal part of the product development process?			
1.2	If a formal DFE programme is not in place have any of the following strategies been used in the design process?			
	Hazardous material avoidance (see section 2) in component structure, coatings.			
	Re-usability			
	Recycled material content			
	Recyclability			
	Thermal convection reduction			
	Disassembly			
	Packaging minimisation			
	Transportation packaging re-use (take-back)			
	Transportation packaging recycled material content			
	Avoidance of transportation packaging coatings and bleaches			
1.3	Are hazardous substances used in any of the product manufacturing processes? Please complete relevant section of Form A1.			
1.4	Are hazardous substances (see Section 2, Question 2.2 for definition in this case) present in the product?			
1.5	Does the company plan to implement a DFE programme?			
2	Section 2 Product Environmental Information	Yes	No	Comments
	The answers to the following questions will provide Nortel with an indication of the supplier's ability to provide Nortel with detailed product environmental performance data. If the supplier answers yes to any of the questions, Nortel requests that they provide the appropriate data in electronic format if possible.			
2.1	Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete relevant section of Form A1 for each component supplied)			
2.2	Is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are considered by Nortel to be those specified in Form A1.(Please complete the hazardous material section of Form A1 for each component supplied)			
2.3	Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel? (Specify the products and provide the data in electronic format if available:)			
2.4	Can the supplier provide guiding information on end-of-life options for supplied products?			

New Nortel Networks Supplier Environmental Assessment Questionnaire Version 3

Confidentiality of Supplier's Information: The information requested and obtained from the supplier in support of this questionnaire and which is identified by the supplier as being of a sensitive or proprietary nature, shall remain confidential and shall not be disclosed to any party outside of Nortel and its Subsidiaries. Where a Non-Disclosure Agreement exists between the supplier and Nortel, then the terms of that agreement shall also apply.

Name of Supplier:	
Address:	

Completion Guidelines: Each of the five categories must be completed. The first question in each category is in column two. The supplier can respond either yes or no (indicated column 30and places an x in the supplier response column. The next question is in the column to the right of the previous answer. The supplier needs to continue answering questions until they reach the bottom of the question tree for the respective category. The first question of the next category starts in column two. Form A1 is supplied as a separate document (tab Form A1below).

Category	Question		Supplier Response			Supplier Response			Supplier Response			Supplier Response	Requirements of supplier
Company environmental policy	Does the company have a documented corporate environmental policy reflecting senior managements commitment to the environment?	yes		Is the policy geared towards continual improvement in pollution prevention and does it specify certain company environmental goals and objectives?	yes		Is a policy statement available to the public?	yes					The supplier must be able to provide Nortel with the policy.
								no					
					no		Is the company considering including targets and objectives?	yes					Evidence of the supplier's intention to include targets and objectives in the environmental policy needs to be available.
								no					
		no		Is the company seeking to generate an environmental policy?	yes								The supplier needs to be able to provide Nortel with up-date reports on how the policy development is progressing
					no								
Environmental regulation	Can the supplier demonstrate through appropriate documentation that procedures are in place to ensure that each site meets all the requirements of relevant national and international environmental protection regulations?	yes		Has a major public safety or environmental pollution incident occured at any of the supplier's sites or has the supplier been charged with non-compliance in the past?	no								Evidence will need to be provided
					yes		Have appropriate measures been taken to reduce the risk to an acceptable level of such an incident occuring again?	yes					A description of appropriate measures taken to minimise the risks of a major environmental incident ocurring and possible associated suspension of product supply must be available.
								no		Will they be taken?	yes		Evidence of a risk management plan must be available.

											no		
		no											
Company environmental management systems	Does the supplier have an environmental management system fully endorsed by senior management?	yes		Can the supplier demonstrate that the system is accredited to ISO 14001 or EMAS?	yes								All relevant documentation needs to be provided in order to verify the statement.
					no		Is the company seeking accreditation?	yes					An intended accreditation date needs to be supplied.
								no		Does the environmental management system meet the requirements of ISO 14001 or EMAS?	yes		Evidence that the supplier's EMS meets the requirements of ISO 14001 needs to be available.
											no		
		no		Is the company considering implementing an environmental management system?	yes								Nortel recommends implementing an ISO 14001 accredited system. A time-frame and plan of implementation needs to be available.
					no								
Process	Has the supplier assessed the environmental performance of its process and implemented programmes to manage and monitor the environmental performance of its processes?	yes		Do the programmes address waste minimisation and recycling issues including recovery options for product packaging and end-of-life takeback/disposal options?	yes								The supplier must be able to demonstrate that appropriate environmental performance monitoring and management programs are in place. Completion of the relevant section of Form A1 detailing hazardous materials used in manufacturing processes is requested.
					no		Are their plans to address these issues?	yes					The supplier must be able to provide Nortel with evidence of plans and time frames for implementation.
								no					
		no		Are their plans to implement such programmes.	yes								Details of the plan and implementation dates need to be made available to Nortel.
					no								

Product	Does the company have a Design for Environment (DFE) programme in place that is a formal part of the product development process and includes a process for communicating product environmental information to the customer?	yes											The supplier needs to be able to demonstrate how DFE principles are used and must provide Nortel with detailed product environmental performance information including product listings of material contents by percentage weight of the whole product. Complete Form A1
		no		Are their plans to integrate DFE principles into the product development process and to communicate product environmental information to the customer?	yes								A plan of implementation, including times and dates must be available and product listings of material contents by percentage weight of the whole product provided (complete Form A1)
					no		Can the company provide detailed information on the environmental attributes / performance of the product throughout the life cycle?	yes					Information and data need to be made available to Nortel including product listings of material contents by percentage weight of the whole product provided (complete Form A1)
								no		Can information be provided on the presence of substances or materials in the product that Nortel consider to be hazardous and therefore should be avoided or declared?	yes		The supplier must provide Nortel with a declaration of the hazardous materials (as specified in the Nortel list of substances to be avoided or declared in Form A1) content of the product (complete relevant section of Form A1).
											no		The supplier cannot provide Nortel with the minimum product environmental information requested by our customers

Appendix IX.

Supplier Pilot Feedback

Summary Report on the Nortel Networks Supplier Environmental Appraisal Procedure (SEAP) Pilot Study 2

Prepared for Supplier A
by Carl Mead.

Environmental Research Engineer
Nortel Networks
Advanced Design Technologies
Harlow Laboratories
LondonRoad
Harlow
Essex
UK
CM17 9NA

1.0 Introduction

The second pilot study was conducted as a part of a broader research programme within the Advanced Design Technologies group on integrating supplier environmental data into the product development process and Product Life Cycle Management (PLCM) activities. The second pilot study was an extension of the first pilot study which focused on the trial of three versions of the new supplier environmental appraisal questionnaire. The aims of the second pilot study were to appraise 27 selected suppliers' environmental performance using the approved test questionnaire from the first study – the Nortel Networks Supplier Environmental Appraisal Procedure (SEAP) questionnaire. The suppliers were selected to represent a broad range of commodity suppliers. The questionnaire is designed to evaluate suppliers in terms of their environmental performance and to provide a means of providing product specific environmental data.

The objective of this report is to provide feedback to the supplier organisations that participated in the trial. The report is available to each participating organisation but the identity of the other participating organisations will not be revealed.

Meeting the requirements of customers, product-focused environmental legislation, ISO 14001 accreditation and generally advancing the practice of ecodesign, requires the transfer of detailed product environmental information throughout the life cycle. Research conducted at Nortel Networks aims to assess the feasibility of such product data transfer and to develop appropriate methods with the supply chain. The Eco-Appraisal is considered a first step in a meaningful open dialogue on product and company environmental performance between Nortel Networks and the supplier.

2.0 Method

2.1 The SEAP Questionnaire

The SEAP questionnaire is a product of extensive research and feedback from the first pilot study. The Nortel Networks Supplier Eco-Appraisal Procedure (SEAP) has been designed to capture environmental information from the supply base that will be used to:

- support Nortel Networks ISO 14001 accreditation;
- provide information for customers of Nortel Networks;
- provide information for purchasers;
- provide information for product designers; and
- provide information for WEEE Directive Compliance.

Layout
The questionnaire consists of three core sections:

Section1: Company Environmental Performance (Part A)
Section 2: Product Environmental Performance (Part B)
Section 3: Form A1 (product information)

Media

The questionnaire is available electronically in Excel and Lotus 123 formats. It is very difficult to complete the questionnaire in hard copy format. Suppliers are encouraged to complete the questionnaire electronically and to return it to Nortel Networks by e-mail or on disk. Options for an Internet version are being investigated.

2.2 Contact Identification in Supplier Organisation

A first contact in each supplier organisation was identified through the Nortel Networks commodity portfolio managers. Further contacts were then identified, such as environmental personnel, by the supplier as required.

2.3 Questionnaire Completion

Each participating supplier was sent the SEAP questionnaire in electronic format (Excel spreadsheet) and was asked to complete it in electronic format. A time frame was given for completion of the questionnaire. In many cases the deadline had to be extended.

3.0 Results

3.1 Supplier Appraisal

Each of the questions in the questionnaire has a score associated with its answer. This enables a quantitative appraisal to be conducted for the purposes of ISO 14001 compliance and continual improvement. The scores for each participating supplier in the study are provided in Appendix I. Only the identity of the one respective supplier is revealed but the results of the others are provided for comparative purposes. The score allocation for each answer is provided in Appendix II. The range of scores attainable for each section and in total are provided in Table 1 as well as the first target scores.

Questionnaire Section	Range of Scores Attainable	1st Target Scores
EMS	0 - 110	110
Eco-Labelling and Product Takeback	0 - 10	0
Manufacturing	-20 - 25	0
Use	-20 - 20	20
Ecodesign	0 - 105	55
Product data provision	0 - 130	30
Total	-40 - 400	215

Table 1. Scores for each section.

Appendix I contains the comparative scores of the suppliers for each section of the questionnaire and the total scores in graphical form. The graphs also show two target scores for each section and a total that should be aimed for – a first target and a preferred target.

* Important note: Supplier A is supplier number 14 in the results.

3.2 Supplier-Specific Feedback and Suggested Next Steps

Supplier A has an excellent overall score - scoring 325 out of a possible 400. The first target score is 215.

The score for policy and EMS is the maximum.

The scores for eco-labelling and takeback, manufacturing and use are reasonable and consistent with other suppliers and meets the first target scores for these sections.

The score for ecodesign is very good.

For product data provision the score is excellent and well above the first target score because of the ability to provide total product material composition data.

Suggested next steps:

Supplier A continue their excellent work on environmental performance and continue providing product material content data as and when it is available. Further investigations on suitable alternatives to hazardous materials used in manufacture and present in the final product which satisfy the functionality and reliability for Nortel Networks applications is encouraged. This can involve working with Nortel Networks in addition to industry-wide groups in collaborative efforts.

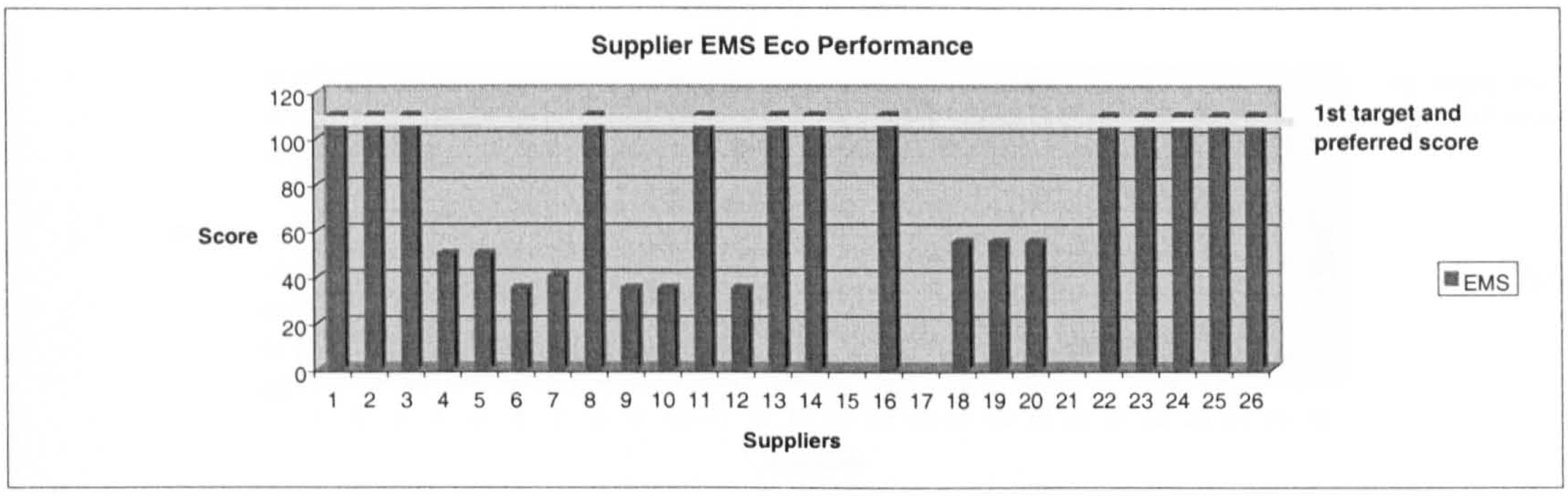
5.0 Further Work

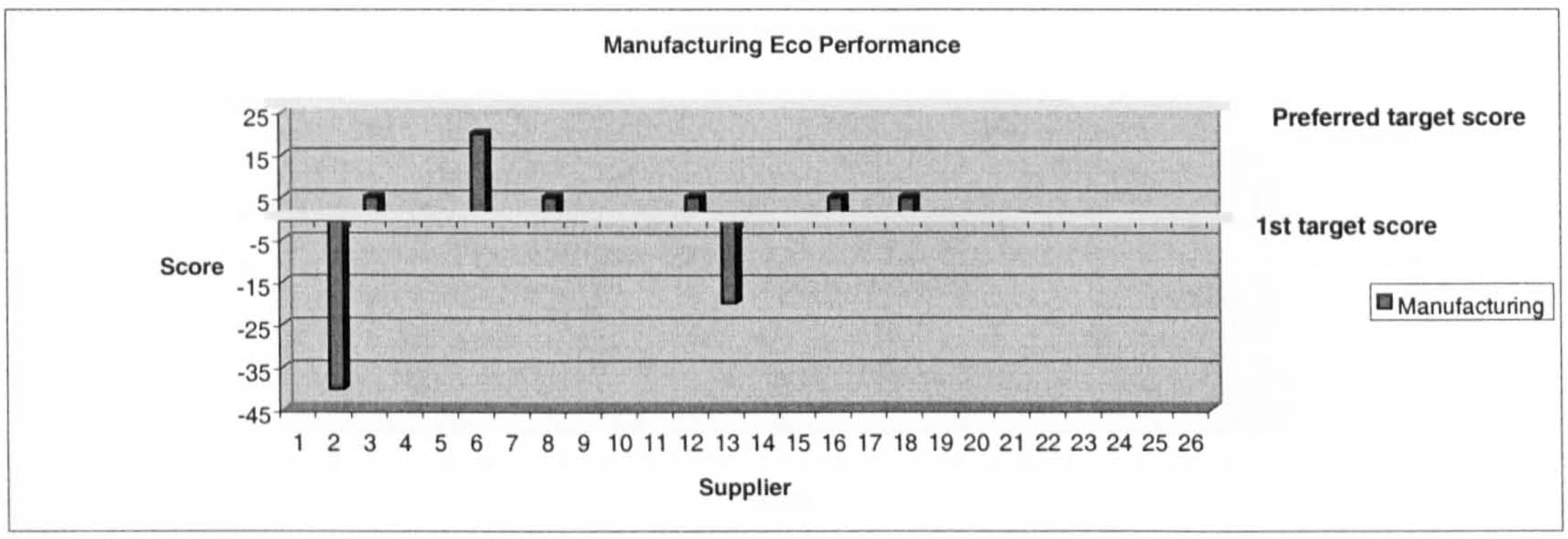
The next steps of the research programme are:

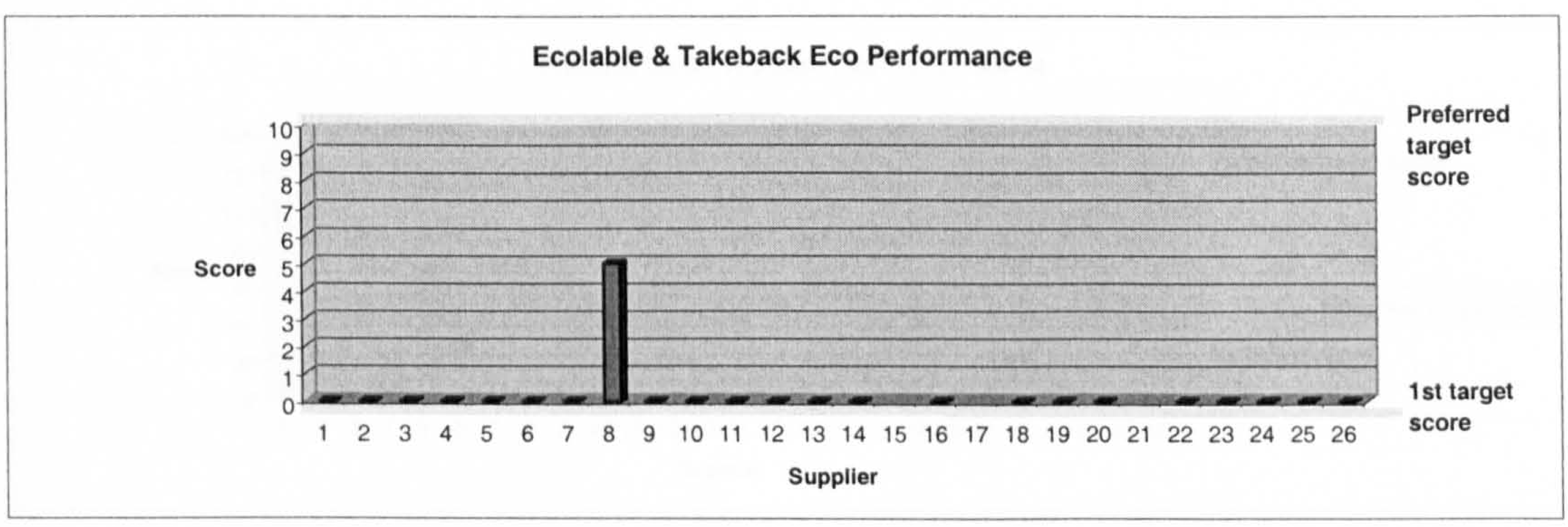
1. to continue open dialogue with suppliers. This will include:
    - encouraging the provision of product data on product part numbers currently being supplied to Nortel Networks;
    - encouraging open dialogue between customer and supplier to enable the development of ideas to improve the environmental performance of the suppliers' products and Nortel Networks products in terms of design and manufacture;

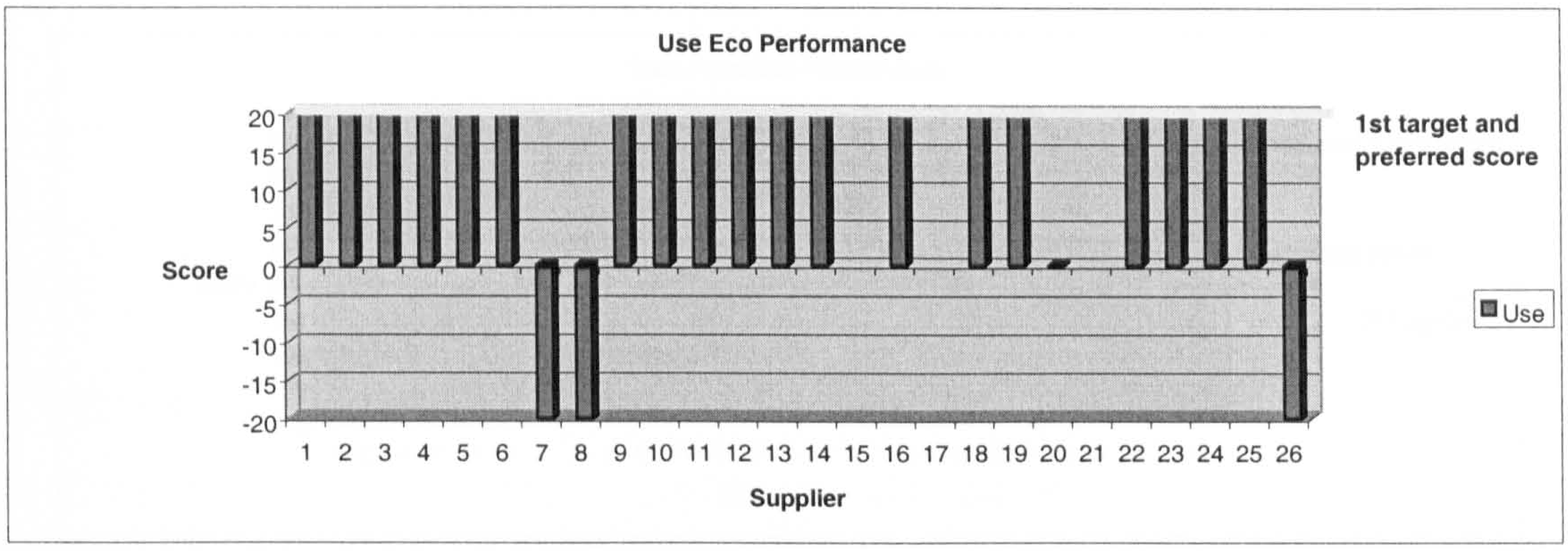
2. to standardise SEAP within Nortel Networks therefore making it the standard procedure for assessing the environmental performance of suppliers and capturing data;
3. to extend the application of SEAP to all production engineering suppliers
4. to develop and implement web-based methods of questionnaire completion and data transfer;
5. to continually add supplier product data to the Nortel Networks component database; and
6. to develop an automated system for the transfer of product environmental data through Nortel Networks product data management systems.
7. in addition, work continues on a formal environmental procurement policy and procedure at Nortel Networks which is due to be implemented soon.

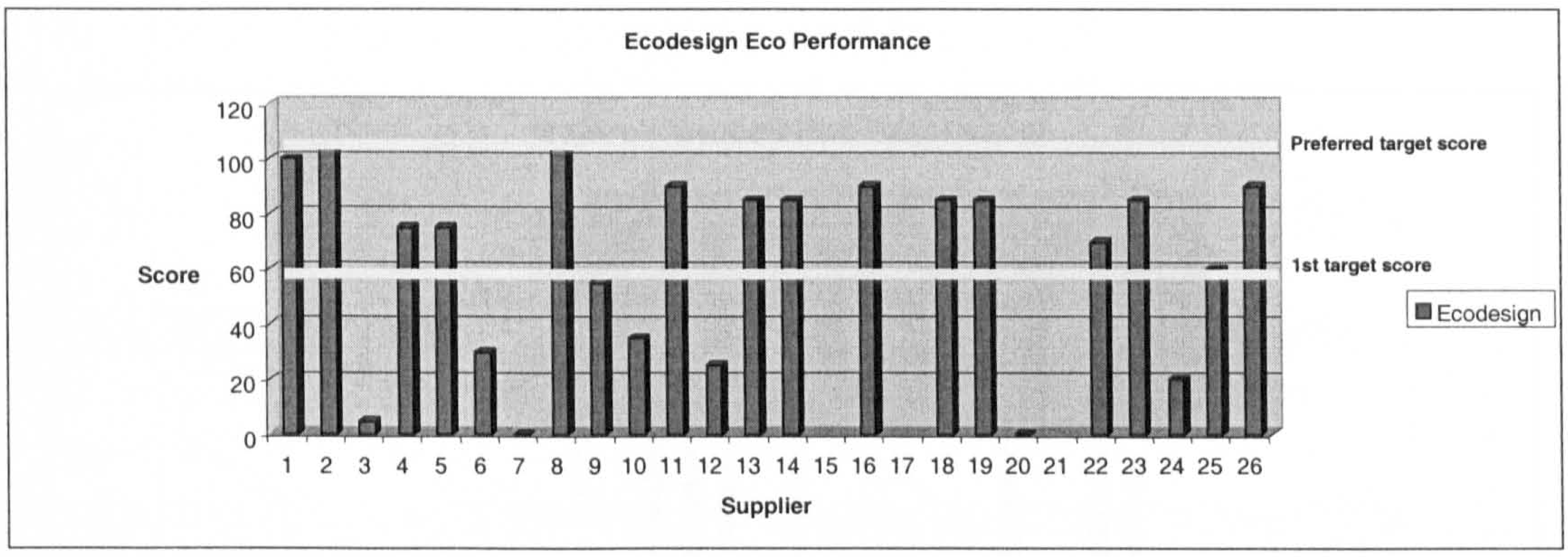
Appendix I

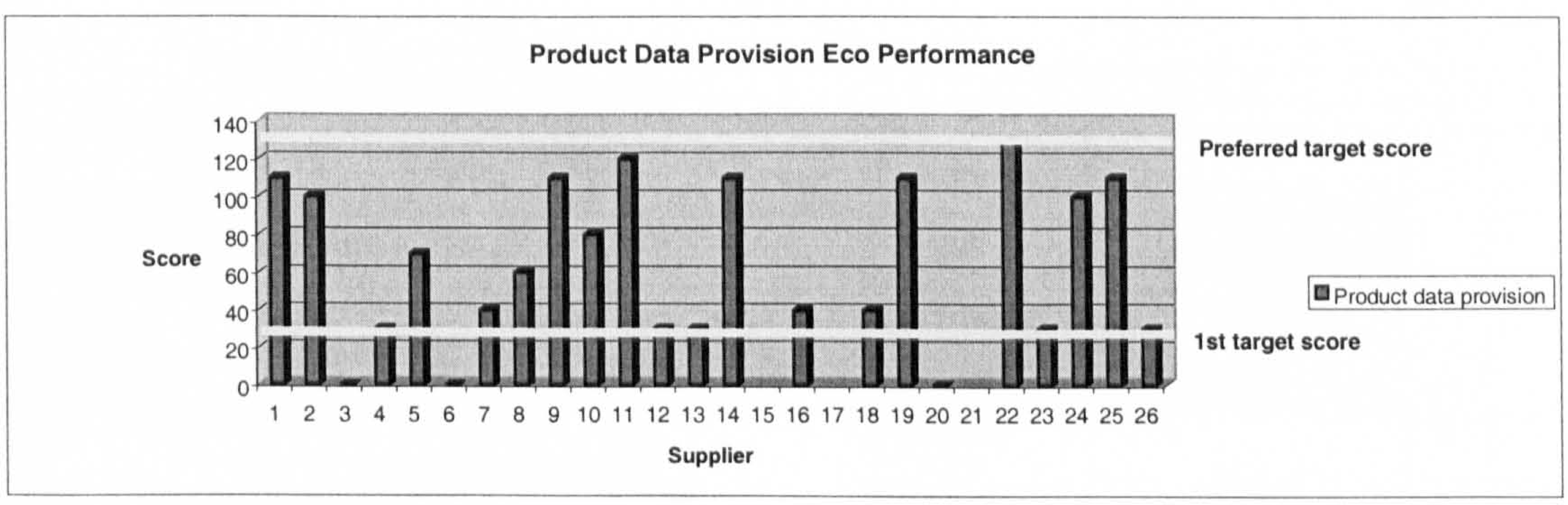

Supplier EMS Eco Performance
120
100
80
60
40
20
0
Score
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Suppliers
1st target and preferred score
EMS

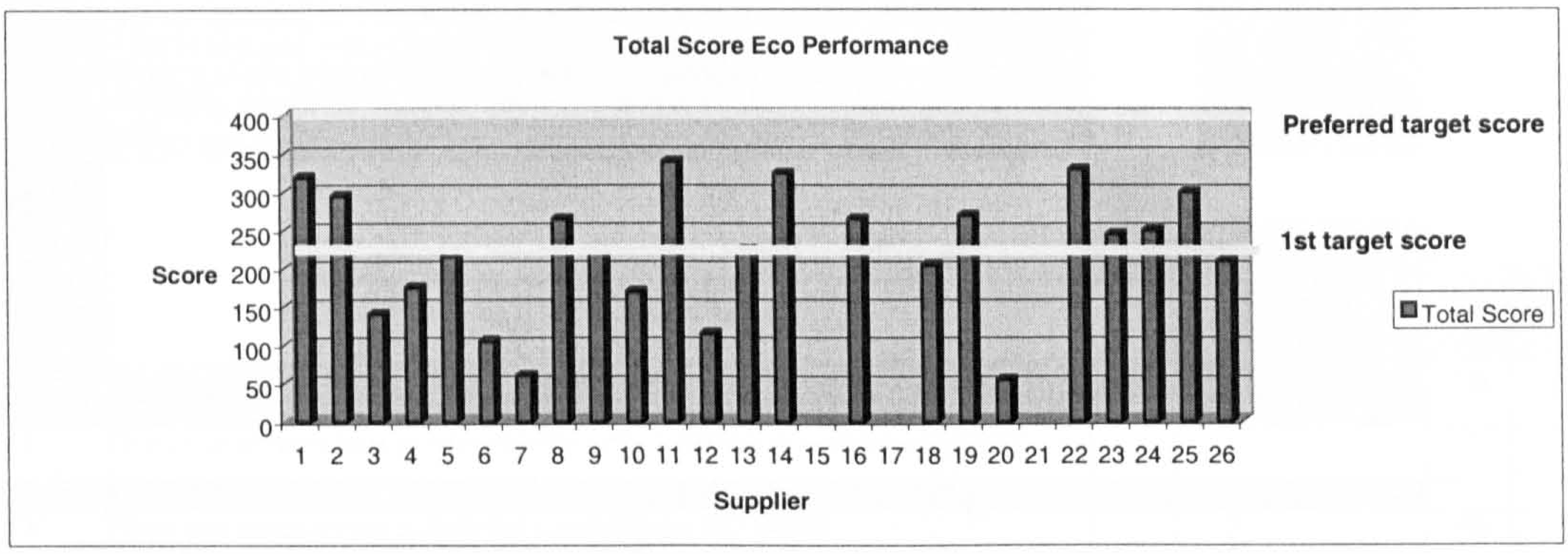

Manufacturing Eco Performance
25
15
5
-5
-15
-25
-35
-45
Score
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Supplier
Preferred target score
1st target score
Manufacturing

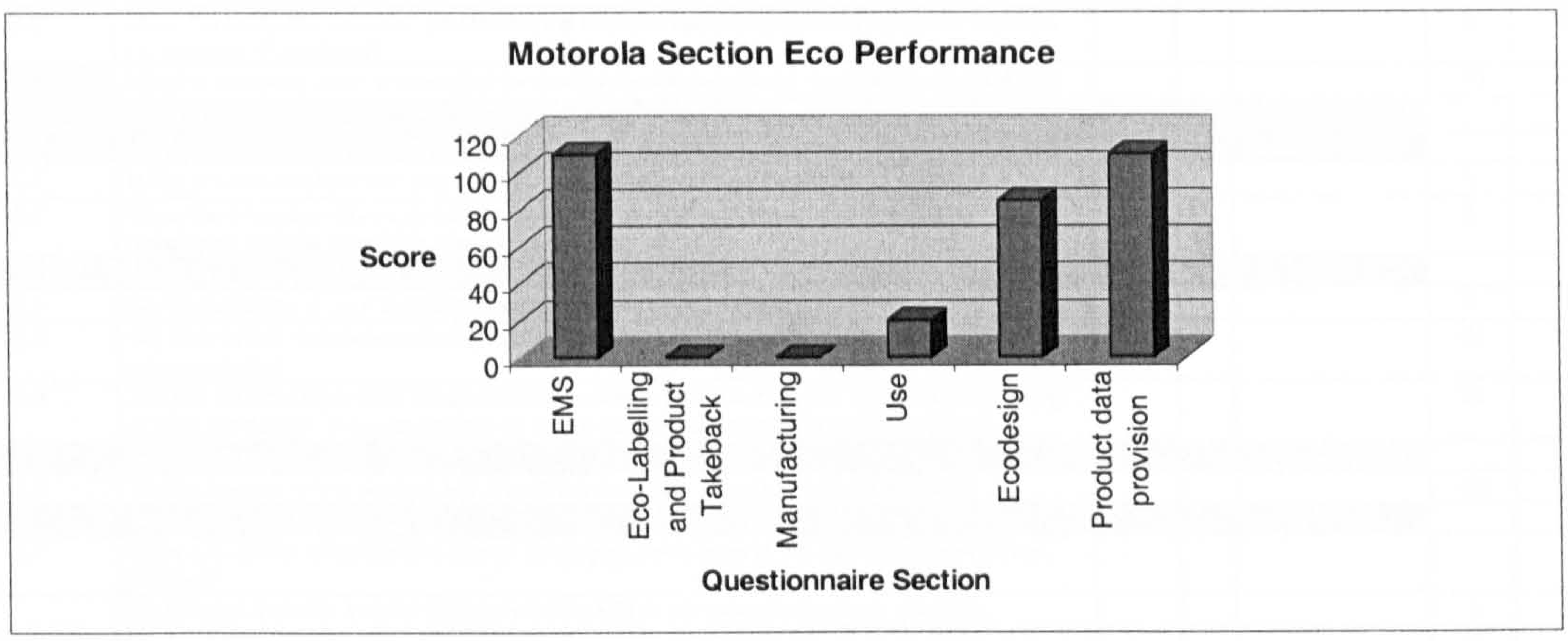

Ecolable & Takeback Eco Performance
10
9
8
7
6
5
4
3
2
1
0
Score
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Supplier
Preferred target score
1st target score


Use Eco Performance
20
15
10
5
0
-5
-10
-15
-20
Score
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Supplier
1st target and preferred score
Use


Ecodesign Eco Performance
120
100
80
60
40
20
0
Score
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Supplier
Preferred target score
1st target score
Ecodesign


Product Data Provision Eco Performance
140
120
100
80
60
40
20
0
Score
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Supplier
Preferred target score
Product data provision
1st target score


Total Score Eco Performance
Preferred target score
1st target score
Total Score
Score
400
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Supplier


Motorola Section Eco Performance
Score
120
100
80
60
40
20
0
EMS
Eco-Labelling and Product Takeback
Manufacturing
Use
Ecodesign
Product data provision
Questionnaire Section

Appendix II

	Nortel Networks Supplier Environmental Appraisal Procedure Questionnaire					
	Confidentiality of Supplier's Information: The information requested and obtained from the supplier in support of this questionnaire and which is identified by the supplier as being of a sensitive or proprietary nature, shall remain confidential and shall not be disclosed to any party outside of Nortel Networks and its Subsidiaries. Where a Non-Disclosure Agreement exists between the supplier and Nortel Networks, then the terms of that agreement shall also apply.					
Name of Supplier:		**Date**				
Address:						
Employee Name and position		**Tel.**			Score	Score
	Part A - Company Environmental Performance				Yes	No
1	**Environmental Policy**	Yes	No	Comments		
1.1	Does your company have an environmental policy supported by senior management?				10	0
2	**Environmental Management System (EMS)**	Yes	No	Comments		
2.1	Does your company have an EMS that is accredited to ISO 14001?				100	0
	If the answer to question 2.1 is yes go to Part B, if the answer is no please answer questions 2.2 - 2.10					
2.2	Does your company have an EMS?				5	0
2.3	Is your company seeking ISO 14001 accreditation?				5	0
2.4	Does the management system track developments in environmental regulations and relevant legislation?				5	0
2.5	Does the EMS include a waste management plan?				5	0
2.6	Does the EMS include a systematic approach to environmental improvement including the use of performance indicators?				5	0
2.7	Does the company have a system in place for assessing the environmental performance of suppliers of products?				5	0
2.8	Does the company have a system in place for assessing the environmental performance of suppliers of services?				5	0
2.9	Does the company consider environmental impacts associated with its transport function, i.e. delivery of products?				5	0
2.10	Has the company been prosecuted for environmental regulatory non-compliance?Details:				-10	10
	Part B Product Environmental Performance (for all products)					
1	**Section 1 Ecolabelling and Product Takeback**	Yes	No	Comments		
1.1	Is the product marked with any voluntary eco-labelling (if applicable)?				5	0
1.2	Does the company have a product takeback programme in place or is one being developed (please specify in comments section).				5	0
2	**Section 2 Manufacturing**					
2.1	Do the activities of your company require regulatory licensing?				0	5
2.2	Are hazardous materials as listed in Form A1 (tab below) used in the manufacturing of your products?				-20	20
2.3	Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? If you answered no to 2.2 above just answer no to this question.				20	0
3	**Section 3 Use**					
3.1	During the use of the product are any of the materials listed in Form A1 emitted?				-20	20
4	**Section 4 Eco-Design**					
4.1	Have any of the following eco-design strategies been used in the design process of the product?					
	Hazardous material avoidance (see section 5.2) in component structure, coatings.				5	0
	Re-usability				5	0
	Marking of plastics				5	0
	Recycled material content				5	0
	Recyclability				5	0
	Thermal convection reduction				5	0
	Disassembly				5	0
	Packaging minimisation				5	0
	Transportation packaging re-use (take-back)				5	0
	Transportation packaging recycled material content				5	0
	Avoidance of coatings and bleaches in transportation packaging				5	0
4.2	Does the company have or intend to have a formalised eco-design programme that is part of the product development process?				50	0
5	**Section 5 Product Environmental Information**	Yes	No	Comments		
	The answers to the following questions will provide Nortel Networks with an indication of the supplier's ability to provide detailed product environmental performance data. If the supplier answers yes to any of the questions, they are requested to use Form A1 for the provision of product material composition data, the indication of the use and phasing out of hazardous materials in the manufacturing process and emissions during use. LCA data should be provided in electronic format if available.					
5.1	Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete component materials declaration in Form A1)				70	0
5.2	If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are presently considered by Nortel Networks to be those on the list in Form A1.(Please complete the hazardous material declaration in Form A1 for each component)				30	0
5.3	Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel Networks? (Specify the products and provide the data in electronic format if available:)				20	0
5.4	Can the supplier provide guiding information on end-of-life management for the supplied products?				10	0

Nortel Networks Supplier Environmental Appraisal Procedure Questionnaire

Confidentiality of Supplier's Information: The information requested and obtained from the supplier in support of this questionnaire and which is identified by the supplier as being of a sensitive or proprietary nature, shall remain confidential and shall not be disclosed to any party outside of Nortel Networks and its Subsidiaries. Where a Non-Disclosure Agreement exists between the supplier and Nortel Networks, then the terms of that agreement shall also apply.

Name of Supplier:	Supplier A	**Date questionnaire co**	1/1/1999
Address:	Austin, TX 78721		
Employee Name and position	Technical Staff engineer ESIH Strategic Programs - Environmental, Safety, and Industrial Hygiene Department	**Tel Contact No.**	512

		Yes	No	Comments	Score	
	Part A - Company Environmental Performance					
1	**Environmental Policy**					
1.1	Does your company have an environmental policy supported by senior management?	X			10	
2	**Environmental Management System (EMS)**	**Yes**	**No**	**Comments**		
2.1	Does your company have an EMS that is accredited to ISO 14001?	X		Motorola's Environmental, Health, and Safety (EHS) Standards require all sites to implement an EHS Management System. Additionally, the corporation is revising these EHS requirements to attain an EHS framework which will be aligned with ISO14001.	100	
	If the answer to question 2.1 is yes go to Part B, if the answer is no please answer questions 2.2 - 2.10					
2.2	Does your company have an EMS?					
2.3	Is your company seeking ISO 14001 accreditation?					
2.4	Does the management system track developments in environmental regulations and relevant legislation?					
2.5	Does the EMS include a waste management plan?					
2.6	Does the EMS include a systematic approach to environmental improvement including the use of performance indicators?					
2.7	Does the company have a system in place for assessing the environmental performance of suppliers of products?					
2.8	Does the company have a system in place for assessing the environmental performance of suppliers of services?					
2.9	Does the company consider environmental impacts associated with its transport function, i.e. delivery of products?					
2.10	Has the company been prosecuted for environmental regulatory non-compliance?Details:		X	Motorola has had no significant EHS violations. See the EHS web page http://www.mot.com/EHS in the EHS Performance section for details. Note: the question may be more appropriately worded to ask if there are any "signficant" compliance issues.		110
	Part B Product Environmental Performance (for all products)					
1	**Section 1 Ecolabelling and Product Takeback**					
1.1	Is the product marked with any voluntary eco-labelling (if applicable)?		X	Not applicable for semiconductor components.	0	
1.2	Does the company have a product takeback programme in place or is one being developed (please specify in comments section).		X		0	
2	**Section 2 Manufacturing**					
2.1	Do the activities of your company require regulatory licensing?	X			0	
2.2	Are hazardous materials as listed in Form A1 (tab below) used in the manufacturing of your products?	X			-20	
2.3	Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? If you answered no to 2.2 above just answer no to this question.	X			20	
3	**Section 3 Use**					
3.1	During the use of the product are any of the materials listed in Form A1 emitted?		X		20	
	Section 4 Eco-Design					
4.1	Have any of the following eco-design strategies been used in the design process of the product?					
	Hazardous material avoidance (see section 5.2) in component structure, coatings.	X			5	
	Re-usability	X			5	
	Marking of plastics		X	Not applicable to semiconductor components.	0	
	Recycled material content		X	Not applicable to semiconductor components.	0	
	Recyclability		X	Not applicable to semiconductor components.	0	
	Thermal convection reduction	X			5	
	Disassembly		X	Not applicable to semiconductor components.	0	
	Packaging minimisation	X			5	
	Transportation packaging re-use (take-back)	X			5	
	Transportation packaging recycled material content	X			5	
	Avoidance of coatings and bleaches in transportation packaging	X			5	
4.2	Does the company have or intend to have a formalised eco-design programme that is part of the product development process?	X			50	105
5	**Section 5 Product Environmental Information** **The answers to the following questions will provide Nortel Networks with an indication of the supplier's ability to provide detailed product environmental performance data. If the supplier answers yes to any of the questions, they are requested to use Form A1 for the provision of product material composition data, the indication of the use and phasing out of hazardous materials in the manufacturing process and emissions during use. LCA data should be provided in electronic format if available.**	**Yes**	**No**	**Comments**		
5.1	Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete component materials declaration in Form A1)	X			70	
5.2	If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are presently considered by Nortel Networks to be those on the list in Form A1.(Please complete the hazardous material declaration in Form A1 for each component)	X			30	
5.3	Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel Networks? (Specify the products and provide the data in electronic format if available:)		X		0	
5.4	Can the supplier provide guiding information on end-of-life management for the supplied products?	X			10	110
				score	325	

Appendix X.

Web-Seap Files

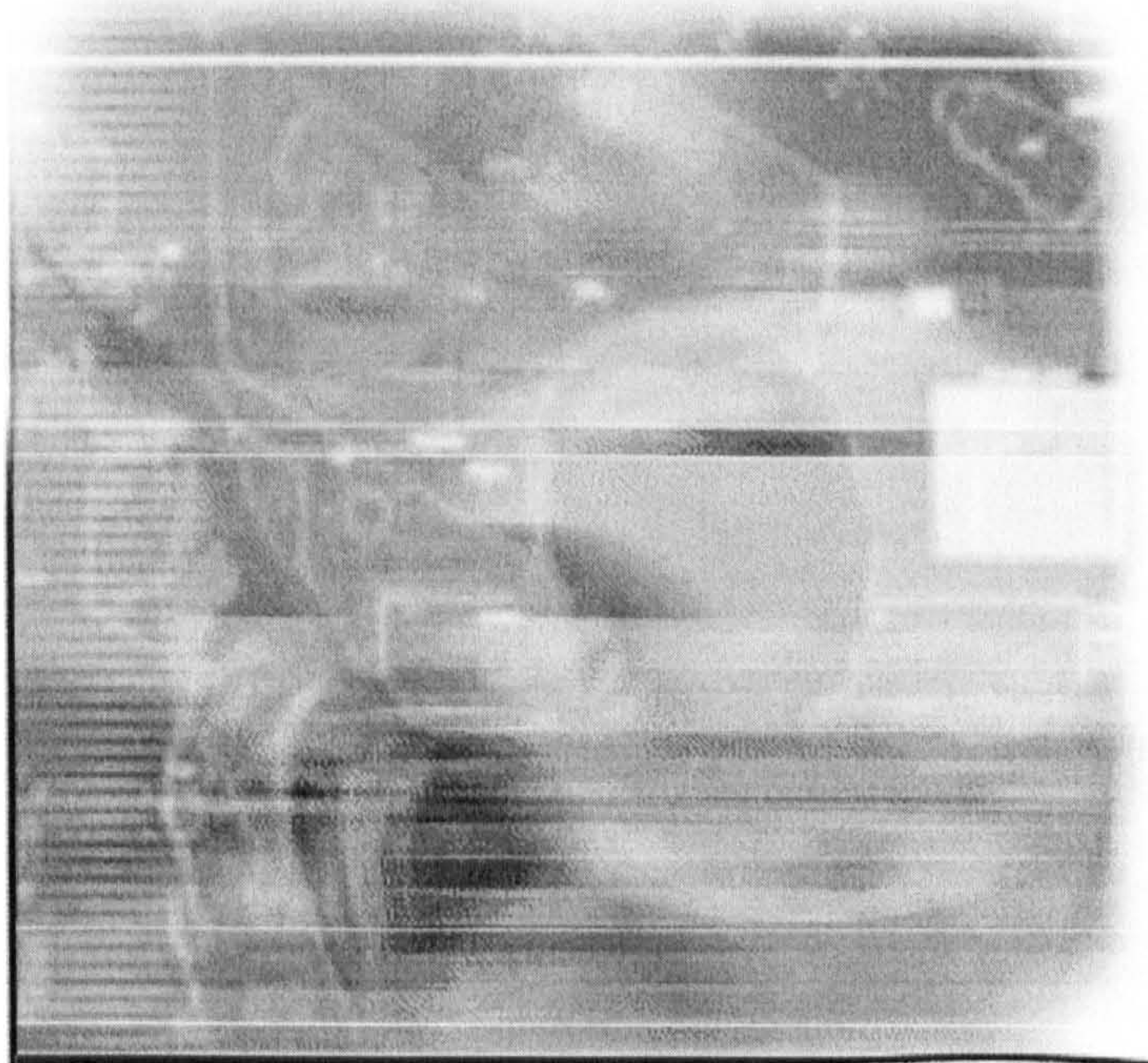
Welcome to Carls SEAP Development Site

This site contains a prototype of a Supplier Eco-Appraisal Procedure questionnaire and eco product data capture tool.

This page is very bare but if you click on the appropriate links below - the tool pages will come to life.

If you are a supplier, click here. This link takes you to the supplier appraisal and information capture tool.

If you are a Nortel Employee, click here. This link takes you to the data already provided by over 20 suppliers that were involved in a pilot project. It includes the suppliers' questionnaire answers, scores and product eco-data.



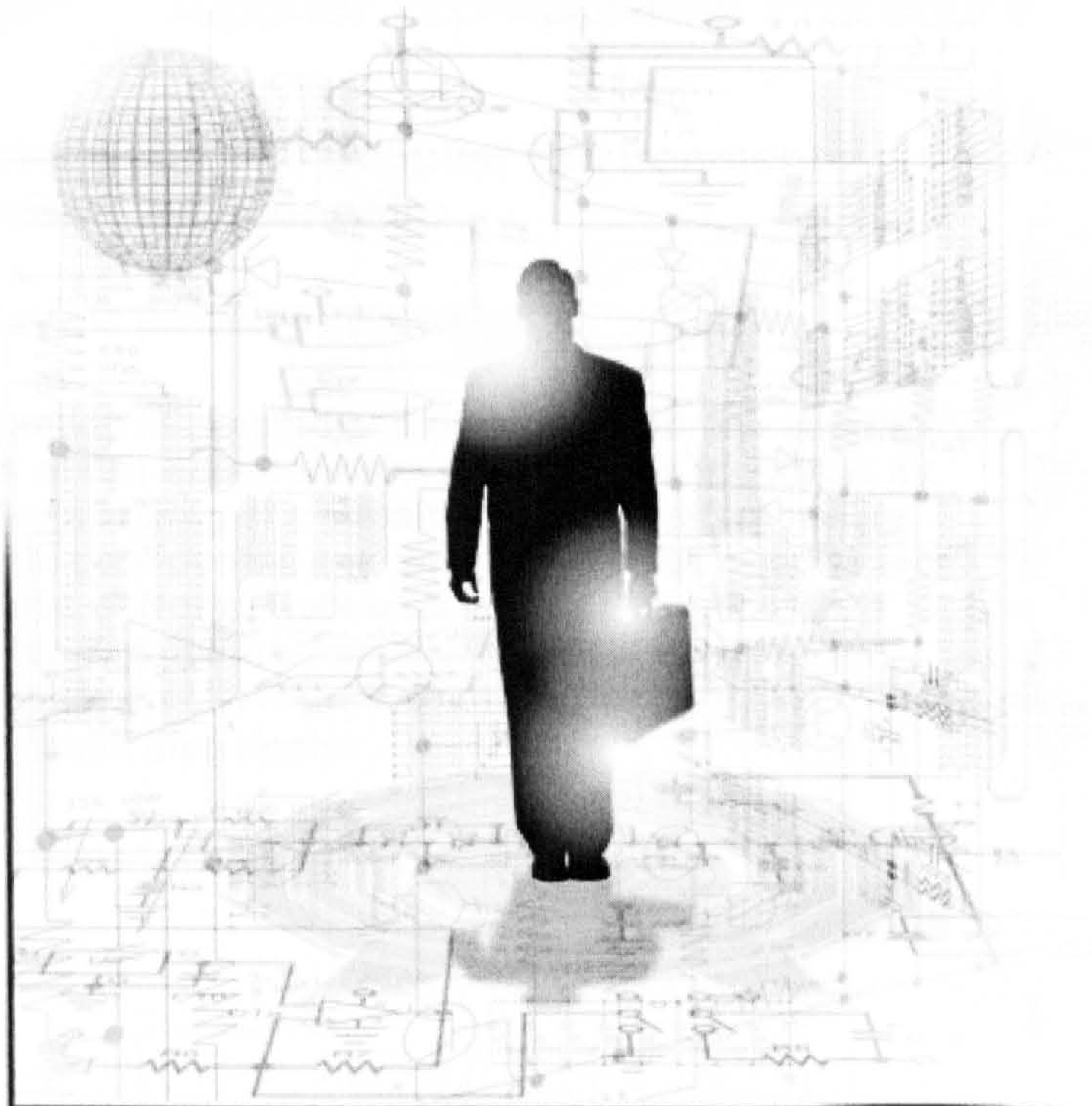
NORTEL NETWORKS

SEAP Questionnaire Data

Welcome to the Supplier Eco-Appraisal Procedure Data Presentation Site.

Here you can view the environmental performance information on production suppliers of Nortel Networks and also commodity specific material composition data.

Product Data	If you are looking for material composition data on a particular part, click here to see a list of the parts in the database, listed by CPC code.
Performance	If you would like to search for the SEAP performance scores on a particular supplier, click on this link to select from a list of the companies in the database.
Answers	Click here to see all the SEAP questionnaire answers from each of the companies that have completed the questionnaire.
Help	



NORTEL NETWORKS

Supplier Eco-Appraisal Procedure

Welcome to the Nortel Networks Supplier Eco-Appraisal Procedure

Guidelines	**Guidelines for questionnaire completion are provided and should be read first. Download .pdf version**
SEAP Questionnaire	**Complete the SEAP questionnaire and submit the information on-line.**
Product Data	**Submit product material composition data on your company's products.**

NORTEL NETWORKS Supplier Eco-Appraisal Procedure

New Nortel Networks Supplier Environmental Assessment Questionnaire

Confidentiality of Supplier's Information:

The information requested and obtained from the supplier in support of this questionnaire and which is identified by the supplier as being of a sensitive or proprietary nature, shall remain confidential and shall not be disclosed to any party outside of Nortel Networks and its Subsidiaries. Where a Non-Disclosure Agreement exists between the supplier and Nortel Networks, then the terms of that agreement shall also apply.

Back Next

NORTEL NETWORKS

SEAP Questionnaire Guidelines

Supplier Guidelines for the Completion of the Nortel Networks Supplier Eco-Appraisal Procedure (SEAP '99)

Introduction

The Nortel Networks Supplier Eco-Appraisal Procedure (SEAP '99) has been designed to capture environmental information from the supply base that will be used to:

- support Nortel Networks ISO 14001 accreditation;
- provide information for customers of Nortel Networks;
- provide information for purchasers;
- provide information for product designers; and
- provide information for WEEE Directive Compliance.

Layout

The questionnaire consists of three core sections:

Section1: Company Environmental Performance (Part A)

Section 2: Product Environmental Performance (PartB)
Section 3: Form A1 (product information)

Completion of the Questionnaire

Information can be freely added to the specified fields.

Instructions

1. Please enter the name and address of the supplier, the name of the person completing the questionnaire, contact details and the date the questionnaire is completed.

2. For Parts A and B please answer the questions with yes or no answers by selecting the appropriate radio button. Explanations can be briefly stated in the comments field if necessary with brief evidence to support the answer. Form A1 is a separate form.

3. For questions 2.2, 2.3, 3.1, 5.1 and 5.2, Form A1 is provided which lists the "hazardous" materials of concern and enables the provision of product material content information (5.1 and 5.2). Instructions are provided on Form A1.

3.1 The name and address of the supplier should be inserted.

3.2. For an answer of yes to question 5.1 the Form should be completed for each part number or range of part numbers and additional "non-hazardous" materials should be added to complete the one hundred percent material composition.

3.3 The part number (s) and a description of the part should be entered.

3.4 The percentage weight of each hazardous material should be entered in the appropriate boxes.

3.5 The percentage weight of each "non hazardous" material should be entered also.

3.6 The actual total weight of the component should be entered in the appropriate box in grams.

3.7 The total sum of the percentage weights for each material must equal one hundred.

3.8 The additional boxes for each part number are used to indicate:
· whether the substance is used in manufacture of the product (if it is listed as in the component it must be used in manufacture ;
· whether it is being phased out of the manufacturing process where applicable; and
· whether the substance is emitted during normal use of the product.

3.9 A form should be used for each part or family of parts supplied to Nortel Networks.

3.10 If the supplier can only provide a hazardous material declaration as asked in question 5.2, the estimated weight percentage of each material present should be entered in each of the appropriate boxes.

3.11 It is acknowledged that certain substances present in the product could be trace contaminants and that a threshold limit for declaration of 0.01% by weight should be used.

Requirements and Definitions

Click on the links below to view the requirements that the supplier should meet to qualify the answers provided for.

Part A
Part B

Final Comments

The questionnaire should be completed according to the instructions provided. If the supplier has any questions regarding the questionnaire they should be directed to their usual point of contact at Nortel Networks who will forward queries to the appropriate Nortel Networks member of staff.

A score will be allocated to each question for the purposes of ISO 14001 continual improvement. The supplier's score will be given back to the supplier so that areas where improvements can be made may be identified. Open dialogue between suppliers and Nortel Networks is encouraged to facilitate the development of improvements in the environmental performance of products.

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NORTEL NETWORKS

SEAP Questionnaire Guidelines

Part A Requirements

Question	Requirement
1.1 Does your company have an environmental policy supported by senior management?	The supplier should be able to provide Nortel Networks with the policy if requested.
2.1 Does your company have an EMS that is accredited to ISO 14001?	The ISO 14001 accreditation certificate should be available for inspection by Nortel Networks.
2.2 Does your company have an EMS?	Documentary evidence such as an EMS manual should be available for inspection by Nortel Networks.
2.3 Is your company seeking ISO 14001 accreditation?	Documentary evidence such as a company plan for gaining ISO 14001 in the next three years should be available for inspection by Nortel Networks staff.
2.4 Does the management system track developments in environmental regulations and relevant legislation?	This should be able to be demonstrated through appropriate EMS documentation that should be available for inspection by Nortel Networks.
2.5 Does the EMS include a waste management plan?	The plan should be available for inspection by Nortel Networks.
2.6 Does the EMS include a systematic approach to environmental improvement including the use of performance indicators?	This should be able to be demonstrated through appropriate EMS documentation that should be available for inspection by Nortel Networks.
2.7 Does the company have a system in place for assessing the environmental performance of suppliers of products?	This should be able to be demonstrated through appropriate EMS documentation that should be available for inspection by Nortel Networks.
2.8 Does the company have a system in place for assessing the environmental performance of suppliers of services?	This should be able to be demonstrated through appropriate EMS documentation that should be available for inspection by Nortel Networks.
2.9 Does the company consider environmental impacts associated with its transport function, i.e. delivery of products?	This should be able to be demonstrated through appropriate EMS documentation that should be available for inspection by Nortel Networks.
2.10 Has the company been prosecuted for environmental regulatory non-compliance?	The supplier is expected to provide brief details of any significant environmental regulatory non-compliance events that have taken place that have resulted in conviction in a court of by a regulatory agency.

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NORTEL NETWORKS

SEAP Questionnaire Guidelines

Part B Requirements

Question	Requirement
1.1 Is the product marked with any voluntary eco-labelling (if applicable)?	Eco-labels or declarations are available such as the Blue Angel, Nordic Swan or ECMA Product Declaration for certain products. If the product has such a label, details should be provided in the comments section of the questionnaire.
1.2 Does the company have a product takeback programme in place or is one being developed?	A documented process for take-back of products or a plan of implementation should be available for inspection by Nortel Networks.
2.1 Do the activities of your company require regulatory licensing?	Regulatory licensing is defined as a licence to operate that is issued by an environmental regulator or government agency because of the nature of the activities conducted by the company. An example is IPC authorisation in the UK.
2.2 Are hazardous materials as listed in Form A1 (tab below) used in the manufacturing of your products?	This is a declaration that the materials listed as hazardous in Form A1 are used in the manufacturing of the product specified by the supplier by part number in Form A1. See section 3.10.
2.3 Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products?	If any of the hazardous materials listed in Form A1 are used during manufacture of the product, but measures are being taken to phase out their use, this should be indicated in the appropriate yellow cells in Form A1. Documented evidence such as a phase-out plan, including the investigation of alternatives should be available for inspection.
3.1 During the use of the product are any of the materials listed in Form A1 emitted?	If, during the normal use of the product, any of the materials listed as hazardous in Form A1 are emitted this should be indicated in the appropriate yellow cells in Form A1.
4.1 Have any of the following eco-design strategies been used in the design process of the product (the strategies are listed in the questionnaire)	The supplier may be asked to verify any answers of "yes" to this question and should be able to provide evidence of a strategy being applied to a specified product if requested by Nortel Networks.Strategy Definitions: 1. Hazardous material avoidance is defined as deliberate actions taken to avoid the use of the materials listed as hazardous in Form A1 in the product. 2. Re-usability is defined as designing the product, or elements of it, for a secondary or even tertiary. 3. Marking of plastics is defined as marking plastics with their type to facilitate recycling. This should be in line with ISO guidelines where appropriate. 4. Recycled material content is defined as the active incorporation of recycled feedstock into the raw material used in the product. 5. Recyclability is defined as optimising the ability of the product or raw materials to be recycled at end of life. 6. Thermal convection reduction is defined as the minimisation and management of heat transfer from a component to the surrounding environment using passive cooling technology. 7. Disassembly is defined as the simplification of product disassembly to assist the recovery of materials. 8. Packaging minimisation is defined as using the minimum volume of packaging required to protect the product in transit.

	9. Transportation packaging re-use (takeback) is defined as maximising the capability of packaging to be re-used. 10. Transportation packaging recycled material content is defined as maximising the use of recycled feedstock in the packaging without reducing functionality below an acceptable level. 11. Avoidance of coatings and bleaches in transportation packaging is defined as designing and manufacturing packaging without using bleaches or unnecessary coatings.
4.2 Does the company have or intend to have a formalised eco-design programme that is part of the product development process?	Documentary evidence of a systematic approach or a plan to introduce environmental criteria into the development of products with the specific aim of minimising the environmental impacts associated with the products' manufacture, use or disposal should be available for inspection by Nortel Networks.
5.1 Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete component materials declaration in Form A1)	An answer of "yes" to this question means that the supplier is in a position to be able to provide the material content by percentage weight of all products currently supplied to Nortel Networks. The information should be entered with the part numbers in Form A1. Please see instructions in section 3.2 and in Form A1. If information is only available on some parts this should be stated in the comments column of the questionnaire.
5.2 If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are presently considered by Nortel Networks to be those on the list in Form A1.	An answer of "yes" to this question means that the supplier is willing to declare the existence of all of the materials listed as hazardous in Form A1. The weight percentage in each part must be declared for each part number in Form A1. Please see instructions above. If information is only available on some parts this should be stated in the comments column of the questionnaire.
5.3 Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel Networks? (Specify the products and provide the data in electronic format if available:	An answer of "yes" to this question means that the supplier can provide life cycle inventory (environmental burden quantification stage of life cycle assessment) data on specified products supplied to Nortel Networks. The supplier should specify which products and provide the data if available.
5.4 Can the supplier provide guiding information on end-of-life management for the supplied products?	An answer of yes to this question means that the supplier can provide information to facilitate end-of-life options for the products supplied to Nortel Networks. The information must be provided and the products specified. If information is only available on some parts this should be stated in the comments column of the questionnaire.

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NORTEL NETWORKS

Supplier Information

Part A

Name of Supplier

Address

Contact Name

and Position

Contact Tel

Date Completed

1. Environmental Policy

1.1 Does your company have any environmental policy supported by the senior management? ○ Yes ○ No

Comments:

2. Environmental Management System (EMS)

2.1 Does your company have an EMS that is accredited to ISO 14001? ○ Yes ○ No

Comments:

If the answer to question 2.1 is yes go to Part B. if the answer is no please answer questions 2.2 - 2.10

Go to Part B

2.2 Does your company have an EMS? ○ Yes ○ No

Comments:

2.3 Is your company seeking ISO 14001 accreditation? ○ Yes ○ No

Comments:

2.4 Does the management system track developments in environmental regulations and relevant legislation? ○ Yes ○ No

Comments:

2.5 Does the EMS include a waste management plan? ○ Yes ○ No

Comments:

2.6 Does the EMS include a systematic approach to environmental improvement including the use of performance indicators? ◯ Yes ◯ No

Comments:

2.7 Does the company have a system in place for assessing the environmental performance of suppliers of products? ◯ Yes ◯ No

Comments:

2.8 Does the company have a system in place for assessing the environmental performance of suppliers of services? ◯ Yes ◯ No

Comments:

2.9 Does the company consider environmental impacts associated with its transport function, i.e. delivery of products? ◯ Yes ◯ No

Comments:

2.10 Has the company been prosecuted for environmental regulatory non-compliance? ◯ Yes ◯ No

Details:

Go to Part B

Part B

Name of Supplier	
Address	
Contact Name	
and Position	
Contact Tel	
Date Completed	
Section A Score	0

1. Ecolabling and Product Takeback

1.1 Is the product marked with any voluntary eco-labelling (if applicable)? ◯ Yes ◯ No

Comments:

1.2 Does the company have a product takeback programme in place or is one being developed (please specify in comments section). ◯ Yes ◯ No

Comments:

2. Manufacturing

2.1 Do the activities of your company require regulatory licensing? ◯ Yes ◯ No

Comments:

2.2 Are hazardous materials as listed in the used in the manufacturing of your products? [Hazardous Materials List] ◯ Yes ◯ No

Comments:

2.3 Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? If you answered no to 2.2 above just answer no to this question. ◯ Yes ◯ No

Comments:

3. Use

3.1 During the use of the product are any of the materials listed in Form A1 emitted? ◯ Yes ◯ No

Comments:

4. Eco-Design

4.1 Have any of the following eco-design strategies been used in the design process of the product?

Check all that apply.

- [ ] Hazardous material avoidance (see section 5.2) in component structure, coatings
- [ ] Re-usability
- [ ] Marking of plastics
- [ ] Recycled material content
- [ ] Recyclability
- [ ] Thermal convection reduction
- [ ] Disassembly
- [ ] Packaging minimisation
- [ ] Transportation packaging re-use (take-back)
- [ ] Transportation packaging recycled material content
- [ ] Avoidance of coatings and bleachings in transportation packaging

Comments:

4.2 Does the company have or intend to have a formalised eco-design programme that is part of the product development process? ○ Yes ○ No

Comments:

5. Product Environmental Information

The answers to the following questions will provide Nortel Networks with an indication of the supplier's ability to provide detailed product environmental performance data. If the supplier answers yes to any of the questions, they are requested to use Form A1 for the provision of product material composition data, the indication of the use and phasing out of hazardous materials in the manufacturing process and emissions during use. LCA data should be provided in electronic format if available.

5.1 Can the supplier provide a list of material contents by percentage weight of the total product? (Please complete component materials declaration in Form A1) ○ Yes ○ No

Comments:

5.2 If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product? Hazardous materials are presently considered by Nortel Networks to be those on the list in Form A1.(Please complete the hazardous material declaration in Form A1 for each component) ○ Yes ○ No

Comments:

5.3 Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel Networks? ○ Yes ○ No

Specify the products and provide the data in electronic format if available:

5.4 Can the supplier provide guiding information on end-of-life options for ○ Yes ○ No the supplied products?

Comments:

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NORTEL NETWORKS

Component Materials Declaration

Please enter a new CPC code in the text box below. Alternatively if you would like to edit an existing component please select one from the list.

CPC code:

Description:

Proceed to Form A1

Existing CPC Codes

Home

Thank you for entering information on .

Your score for Section A was 0 out of 110.
Your score for Section B was 0 out of 290.

This gives you a total score of 0 out of 400.

NORTEL NETWORKS

Component Materials Declaration

Supplier: **Aromat_Corporation** CPC: **A0376555** Total Weight: **2 g**
Description:

Material	Percentage of Total Weight	Used in Manufacturing Process?	Phase Out of Use Planned?	Emitted During Use?
Hazardous Metals				
Arsenic and compounds	0	No	NA	No
Beryllium and compounds	0.16%	Yes	No	No
Cadmium and compounds	0	No	NA	No
Chromium (VI) and compounds	0	No	NA	No
Lead and compounds	0.22%	Yes	No	No
Mercury and compounds	0	No	NA	No
Nickle and compounds	0.01%	Yes	No	No
Hazardous Organics				
Halogenated/Brominated Flame Retardents	5.8%	Yes	No	No
Ozone Depleting Substances (HCFCs etc)	0	No	NA	No
PVC	0	No	NA	No
Polychlorinated biphenyls (PCB)	0	No	NA	No
Polybrominated biphenyls (PBB)	0	No	NA	No
Polybrominated diphenyl ethers (PBDE)	0	No	NA	No
Chlorinated Hydrocarbons (Chloroparrafins, others)	0	No	NA	No
Nonylphenol etoxylates (NPE)	0	No	NA	No
Other				

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NORTEL NETWORKS

Component Materials Declaration

Click on a CPC code to view the material composition of the component.

CPC	Name of Suppliers who provide Nortel with this part (click for contact information)
A0376555 A0615254 A0627370 A0608995 A0323848	• Aromat_Corporation
A0628191 A0329249 A0293769 A0312156	• AVX_Corporation
Tin_Lead_PWB_V1 Tin_Lead_PWB_V2 Tin_PWB_V3 Organic_Coat_PWB	• Hadco_Corporation
39CMC01010ABT A0680667 39CMC03004ABX HM6264FP HM628128FP HM62256FP A0649732 A0617524	• Hitachi
SOIC_8 SOIC_14 SOIC_16 SOIC_20W PLCC_44 PDIP_8 PDIP_14 PDIP_16 PDIP_20 PDIP_24N PDIP_24W PLCC_20 TSSOP_14 QFP64 QFP44 QFP80 PQFP132 LQFP100	• Motorola_SPS
All_Magnetics	• Pulse_Engineering
PWB_Estimate	• Sanmina_Corporation
A0385122 A0742915 A0368228 A0383429 A0383931	• ST_Microelectronics

All_plastic_parts
All_ceramic_parts

- Texas_Instruments_Inc

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NORTEL NETWORKS

SEAP Performance

Supplier List: Click on the name of a supplier to view their answers to the SEAP questionnaire.

Supplier	Section A Score	Section B Score	Total Score
	0 / 110	70 / 290	**70 / 400**
	0 / 110	0 / 290	**0 / 400**
	0 / 110	0 / 290	**0 / 400**
	0 / 110	0 / 290	**0 / 400**
	0 / 110	0 / 290	**0 / 400**
Amp_Inc	110 / 110	230 / 290	**340 / 400**
Aromat_Corporation	110 / 110	205 / 290	**315 / 400**
Astec_Power_Solutions	110 / 110	30 / 290	**140 / 400**
AVX_Corporation	50 / 110	125 / 290	**175 / 400**
Bourns	50 / 110	165 / 290	**215 / 400**
CMAC	35 / 110	70 / 290	**105 / 400**
CP_Clare	40 / 110	20 / 290	**60 / 400**
Delta_Electronics	110 / 110	155 / 290	**265 / 400**
FCI	35 / 110	185 / 290	**220 / 400**
Hadco_Corporation	35 / 110	140 / 290	**175 / 400**
Hitachi	110 / 110	230 / 290	**340 / 400**
JPM	30 / 110	80 / 290	**110 / 400**
Mitsubishi_Electric_Corporation	110 / 110	115 / 290	**225 / 400**
Motorola_SPS	110 / 110	215 / 290	**325 / 400**
Nichicon	110 / 110	155 / 290	**265 / 400**
Pulse_Engineering	55 / 110	150 / 290	**205 / 400**
Sanmina_Corporation	55 / 110	215 / 290	**270 / 400**
Solectron	60 / 110	40 / 290	**100 / 400**
ST_Microelectronics	110 / 110	220 / 290	**330 / 400**
Texas_Instruments_Inc	110 / 110	135 / 290	**245 / 400**

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Component Materials Declaration

Please select your company from the list below to add a new / or edit an existing part. If you do not see your companys n
codes and materials data of supplied parts.

Name of Supplier	List of CPC Codes of Parts Supplied
Amp_Inc	
Aromat_Corporation	A0376555 A0615254 A0627370 A0608995 A0323848
Astec_Power_Solutions	
AVX_Corporation	A0628191 A0329249 A0293769 A0312156
Bourns	
CMAC	
CP_Clare	
Delta_Electronics	
FCI	
Hadco_Corporation	Tin_Lead_PWB_V1 Tin_Lead_PWB_V2 Tin_PWB_V3 Organic_Coat_PWB
Hitachi	39CMC01010ABT A0680667 39CMC03004ABX HM6264FP HM628128FP HM622
JPM	
Mitsubishi_Electric_Corporation	
Motorola_SPS	SOIC_8 SOIC_14 SOIC_16 SOIC_20W PLCC_44 PDIP_8 PDIP_14 PDIP_16 PDIP_
Nichicon	
Pulse_Engineering	All_Magnetics
Sanmina_Corporation	PWB_Estimate
Solectron	
ST_Microelectronics	A0385122 A0742915 A0368228 A0383429 A0383931
Texas_Instruments_Inc	All_plastic_parts All_ceramic_parts

NORTEL NETWORKS Company Supplier Performance

SEAP Data for **Amp_Inc**. Completed **27/01/99**.

Part A

1. Environmental Policy	Answer	Score
1.1 Does your company have any environmental policy supported by the senior management?	**Yes**	**10**
Comments: **Translated into 14 languages**		
2. Environmental Management System (EMS)		
2.1 Does your company have an EMS that is accredited to ISO 14001?	**yes**	**100**

Part B

1. Ecolabling and Product Takeback		
1.1 Is the product marked with any voluntary eco-labelling (if applicable)?	No	0
1.2 Does the company have a product takeback programme in place or is one being developed (please specify in comments section).	No	0
2. Manufacturing		
2.1 Do the activities of your company require regulatory licensing?	Yes	0
2.2 Are hazardous materials as listed in the used in the manufacturing of your products?	Yes	-20
2.3 Are you attempting to limit the use of the materials listed in Form A1 in the manufacturing of your products? If you answered no to 2.2 above just answer no to this question.	Yes	20
3. Use		
3.1 During the use of the product are any of the materials listed in Form A1 emitted?	No	20
4. Eco-Design		
4.1 Have any of the following eco-design strategies been used in the design process of the product? The following have been specified. Hazardous material avoidance, Re-usability, Marking of plastics, Recycled material content, Recyclability, Disassembly, Packaging minimisation, Transportation packaging re-use (take-back), Transportation packaging recycled material content, Avoidance of coatings and bleachings in transportation packaging.		50
4.2 Does the company have or intend to have a formalised eco-design programme that is part of the product development process?	Yes	50
5. Product Environmental Information		
5.1 Can the supplier provide a list of material contents by percentage weight of the total product?		
Comments: yes		
5.2 If 5.1 is not possible, is the supplier prepared to sign a declaration of hazardous materials content in the product?	Yes	30
5.3 Can the supplier provide Life Cycle Inventory data on any of the products supplied to Nortel Networks?	Yes	20
5.4 Can the supplier provide guiding information on end-of-life options for the supplied products?	Yes	10
Total SEAP Questionnaire Score		**340**

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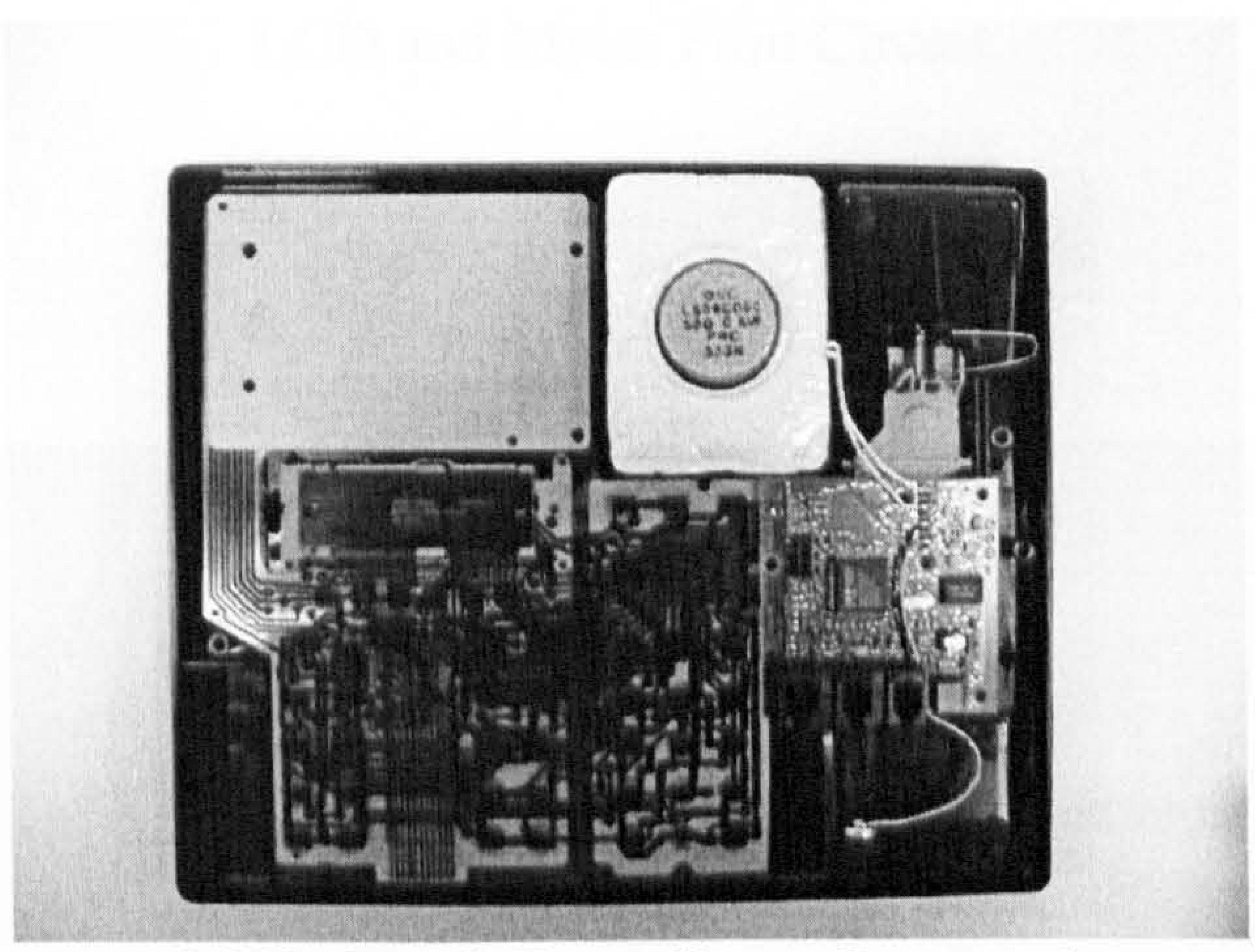
Appendix XI.

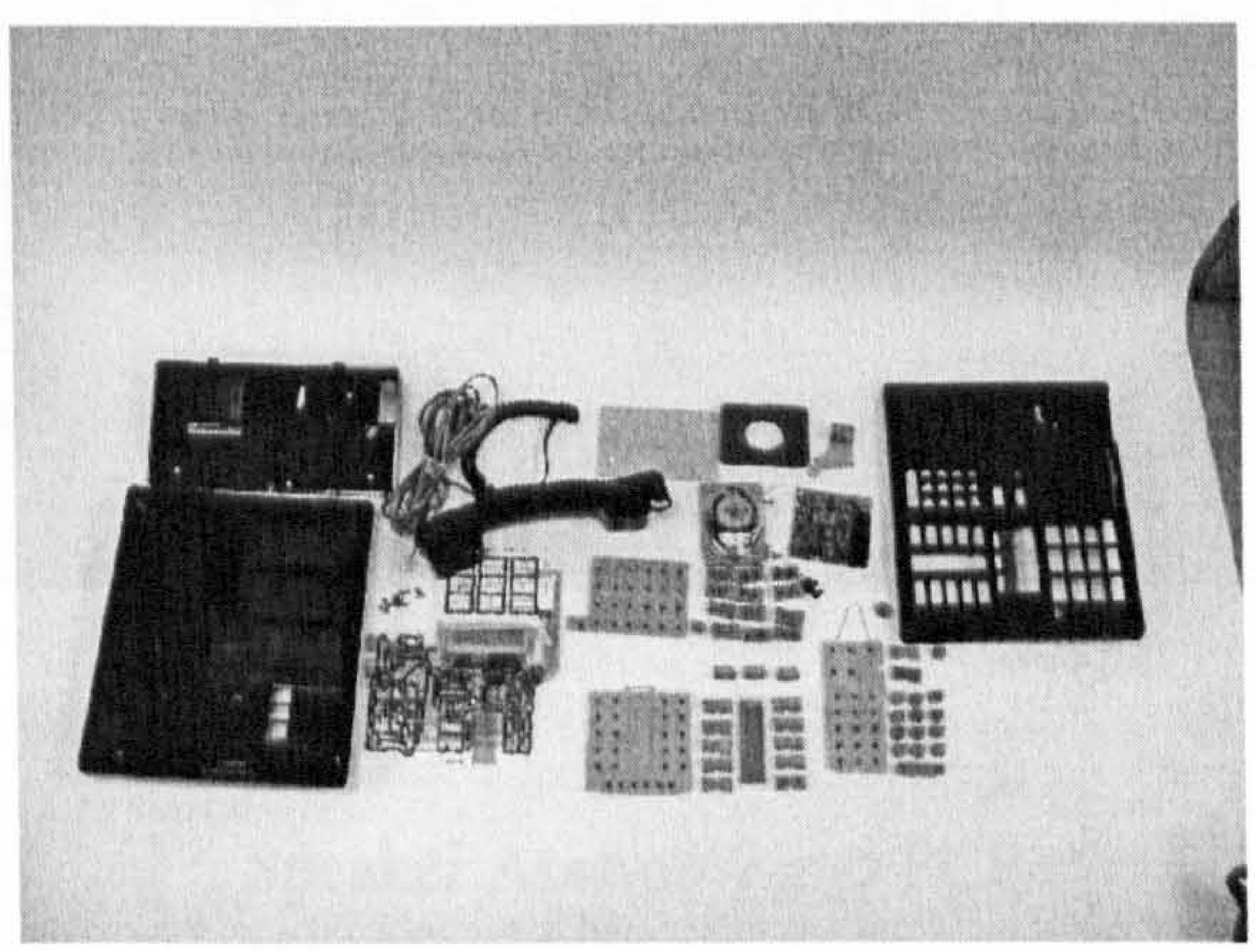
M7310 Phone Images

Appendix XI. M7310 Telephone Images

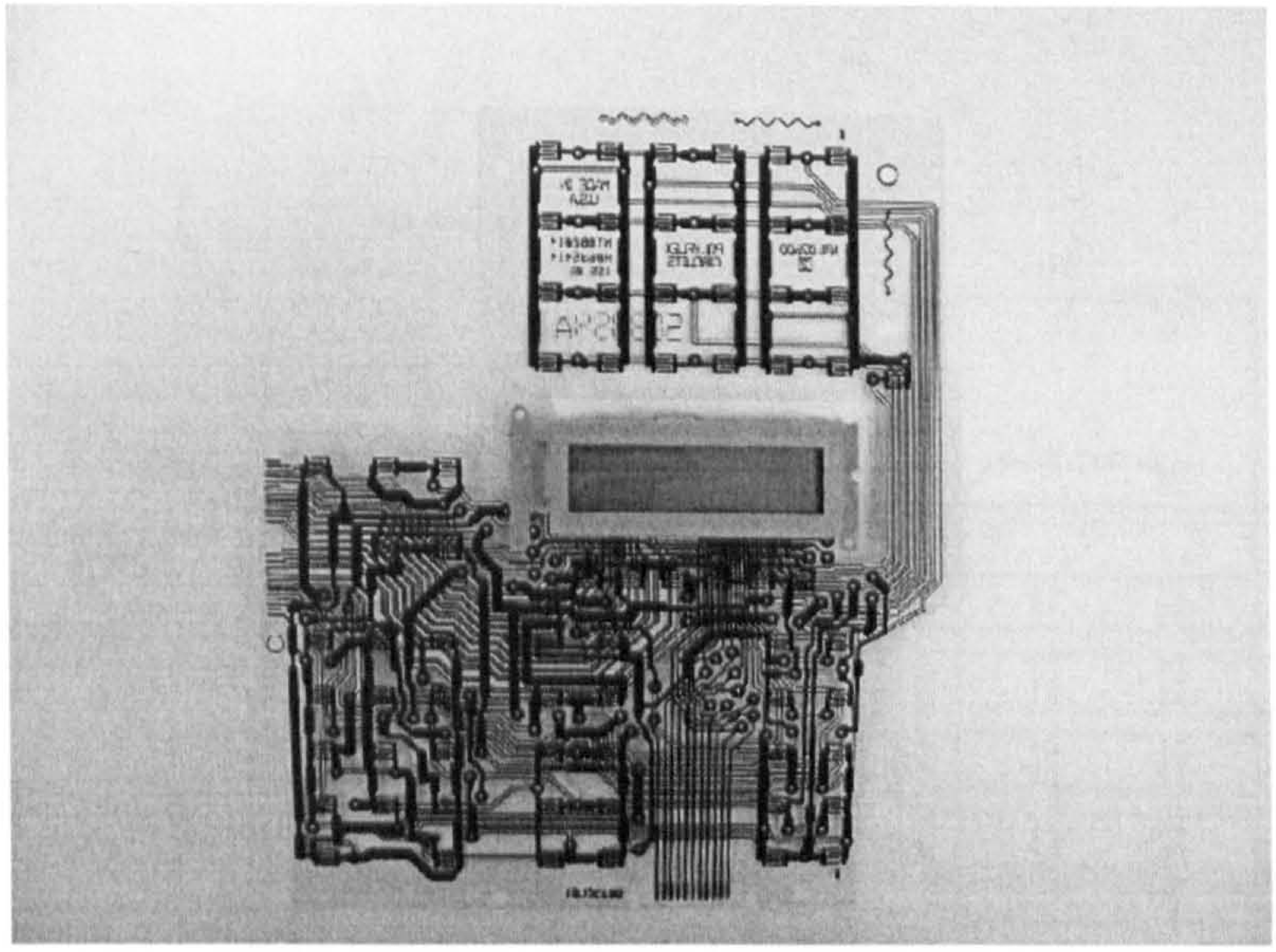
M7310 Telephone Front View



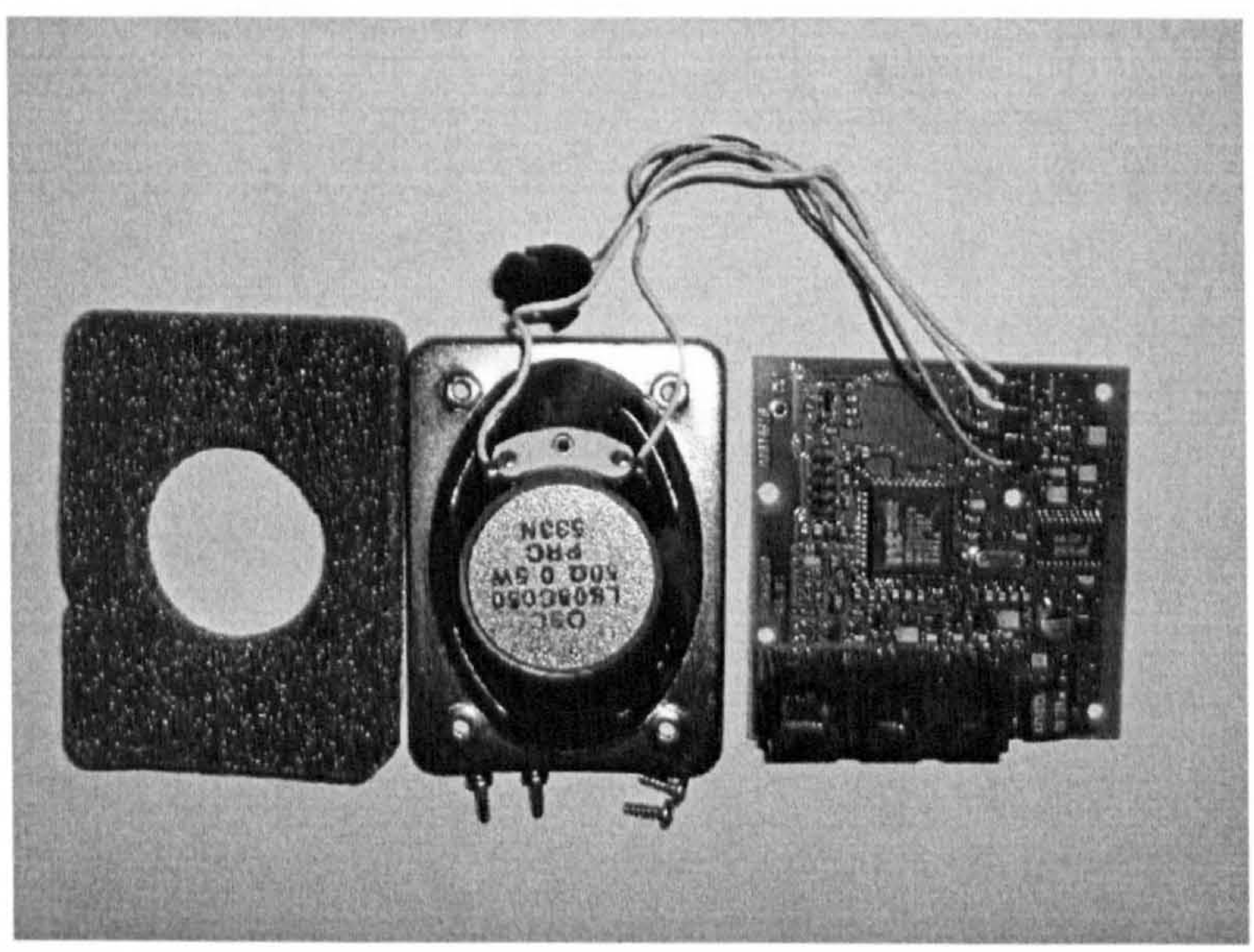
M7310 with Front Cover Removed



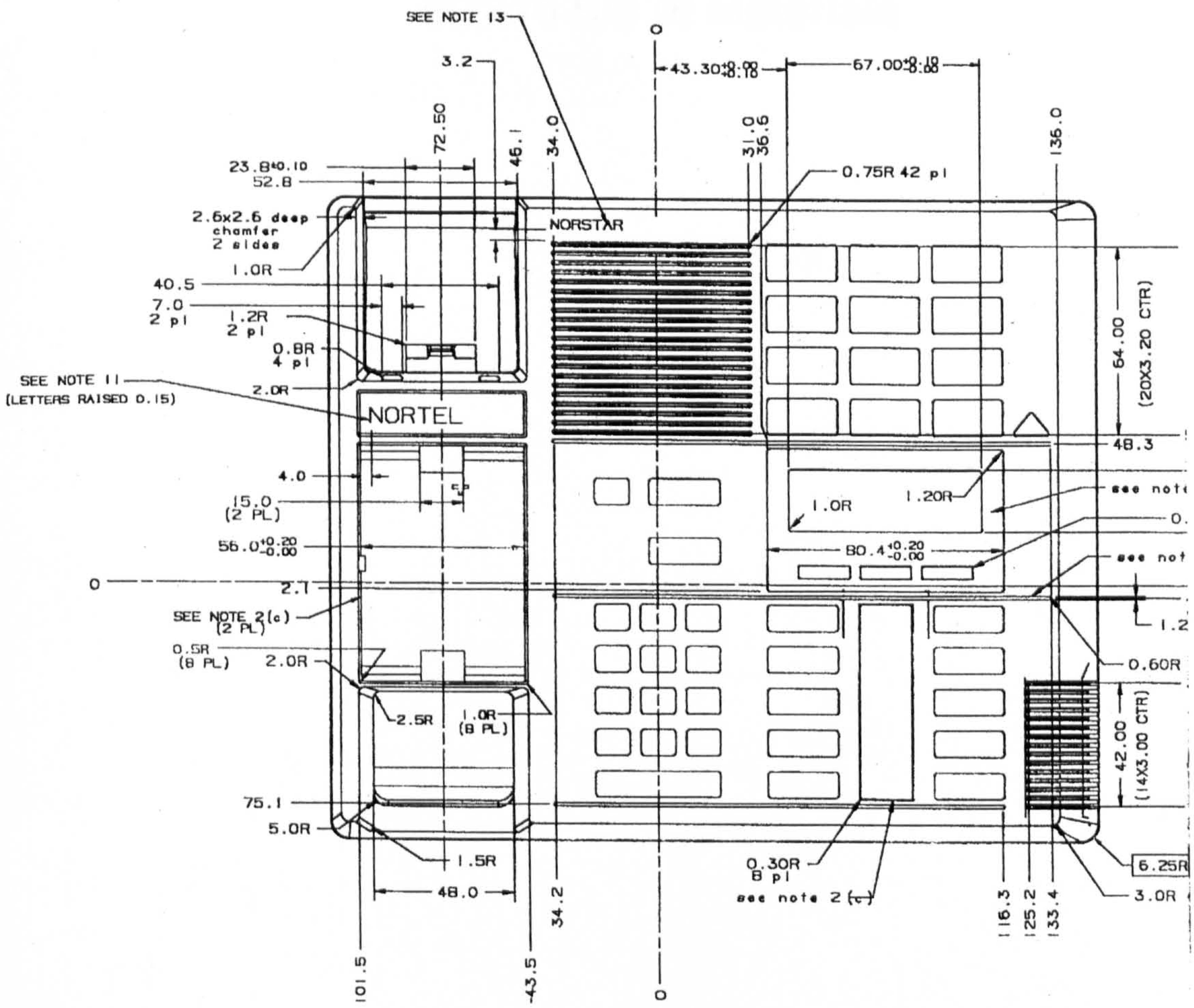
M7310 All Disassembled Parts



LCD and Mylar Film Circuit



Speaker Assembly and PCB



Schematic of M7310 Top Cover

Appendix XII.

M7310 Bill of Materials

Appendix XII BoM of M7310

Product Structure Report NT8B22A-93							Prices aren't available for all components. The price of some components without given values may well be captured in the sub-assembly price (refer to BoM hierarchy in column A. Indivdual prices were sourced from the Nortel supply management database.						
	CIL	REL	RAT	CPC	Qty		Curent New Price US$ April 2001 (based upon average price from buys throughout 2000	Supplier 1	Supplier 2	Supplier 3	Supplier 4		
NT8B22AA-93	29	14	STD	A0372003		FEATURED SET ASSY., UK, BTS LIGHT GREY						H	AS
-A0600638				A0600638	1	CORRUGATED CARTON	0.296	No supplier recommended				C	
-NPS50318-01L2				A0324052	1	UK LINE CORD (3.0M, UK CONNECTOR) SEE NOTES	0.523	090868 (Huan Hsin Co)	067016 (Getty Connections Limited)	135960 (Adirondack Wire & Cable)		C	CM
-NPS50318-07L02				A0336845	1	HANDSET CORD, DOLPHIN GREY	0.547	090868 (Huan Hsin Co)	067016 (Getty Connections Limited)	135960 (Adirondack Wire & Cable)		H	PT
-NT0C09EL-93	11	3	STD	A0410514	1	HANDSET GLOBAL NORSTAR (DOL GREY)	2.517	PM Portland	Dynacast Limited	Norlar Inc		M	AS
--NT0C10AW	4	1	STD	A0636891	1	GLOBAL HANDSET SUBASSEMBLY - SOLDER TAB	ND/NA					H	AS
---NT0C06AO	1	D1	DEV	A0636889	1	EURO. RECEIVER UNIT ASSEMBLY - SOLDER TAB	ND/NA					H	AS
----P0625869				P0625869	1	FERRULE	ND/NA	None recommended				H	PT
----P0730958				P0730958	1	FRONT COVER	ND/NA					C	CM
----P0812729	2	1	STD	P0812729	1	MOTOR ASSEMBLY - AQ RECEIVER	ND/NA					H	PT
-----P0625853				P0625853	1	FLUX COIL	ND/NA					C	CM
-----P0625858	1	1	STD	P0625858	1	POLE PIECE & MAGNET ASSY	ND/NA					H	AS
------P0633575	1	1	STD	P0633575	1	POLE PIECE & MAGNET ASSY	ND/NA					H	AS
-------P0625859				P0625859	1	UPPER POLE PIECE	ND/NA					C	CM
-------P0625860				P0625860	1	MAGNET	ND/NA					C	CM
-------P0625861	1	1	STD	P0625861	1	LOWER POLE PIECE ASSY	ND/NA					H	AS
--------P0625862				P0625862	1	CENTRE POLE PIECE	ND/NA					C	CM
--------P0625863				P0625863	1	LOWER POLE PIECE	ND/NA					C	CM
------R0105961				R0105961	1	SINGLE COMPONENT ETHYL CYANOACRYLATE INSTANT ADHES	ND/NA	008292 (Loctite Corp)				C	
-----P0629393				P0629393	1	CONNECTOR	ND/NA					C	CM
-----P0730959	2	1	STD	P0730959	1	DIAPHRAGM ASSEMBLY	ND/NA					H	AS
------P0625857				P0625857	1	VOICE COIL	ND/NA					C	CM
------P0730960				P0730960	1	DIAPHRAGM	ND/NA					C	CM
------R0117843				R0117843	1	ACRYLATED URETHANE ONE COMPONENT, THIXOTROPIC ADHE	ND/NA	008292 (Loctite Corp)				C	CM
-----P0808055				P0808055	2	RECEIVER SOLDER TAB CONNECTOR	ND/NA					C	CM
-----R0109942				R0109942	1	ACRYLATE MODIFIED, LIQUID, CLEAR, POTTING AND ENCA	ND/NA	008292 (Loctite Corp)				C	
-----R0117893				R0117893	1	ADHESIVE/SEALANT, ONE PART RTV SILICONE RUBBER, CL	ND/NA	008292 (Loctite Corp)				C	CM
----P0812730	1	1	STD	P0812730	1	REAR HOUSING ASSEMBLY - AQ RECEIVER	ND/NA					H	AS
-----P0593893				P0593893	1	ACOUSTIC RESISTANCE DISC	ND/NA					C	CM
-----P0813753				P0813753	1	REAR HOUSING	ND/NA					H	PT
---NT0C1006	2	2	DEV	A0632956	1	DFM HANDSET PWB (bareboard)	ND/NA					H	AS
---P0726346				P0726346	1	MICROPHONE ADAPTER COVER	ND/NA					C	
---P0745101				P0745101	1	MICROPHONE ADAPTOR-GLOBAL	ND/NA					C	
---P0746434				P0746434	1	JACK ASSEMBLY	ND/NA	323492 (Framatome Connectors Canada)				H	DN
---QD-1N4740A				A0254478	1	DIODE REF 10V 1W 5%	ND/NA	003943 (Microsemi Corp)	004502 (Philips Components)	370624 (ON Semiconductor Semiconductor Components Ind L)		C	CM
---QUAG12A				A0605079	1	MICROPHONE ELECTRET OMNIDIREC TERMINALS: STR PC	ND/NA	004646 (Primo Microphone Inc)				C	CM
---R0105860				R0105860	0	TAPE, NYTEX NY-76W30 WHITE		007445 (B&SH Thompson Co Ltd)				C	
---P0601014				P0601014	1	SCREW,TYPE B PAN HD CR1A 2.2X.80 8.0 LG, S, 289A	ND/NA	000403 (Process Products Ltd)	032507 (Century Fasteners Corp)			C	CM
---P0661901				P0661901	1	RECEIVER GASKET	ND/NA					C	CM
---P0802894				P0802894	1	ACOUSTIC SEAL	ND/NA					C	CM
---P0802895				P0802895	1	TRANSMITTER GASKET	ND/NA					C	CM
--P1014093				P1014093	1	NORSTAR DFM INSTRUMENT SECTION	ND/NA					H	PP
--P1014193				P1014193	1	DFM HANDSET COVER	ND/NA					H	PP
--R0109833				R0109833	1	PKG BAG PLAIN POLYETHYLENE L=13.00 W=6.00IN	ND/NA	000136 (Crawford Packaging Materials Ltd)				C	CM
-NT6B9550	2	2	STD	A0395023	1	FEATURE SET STAND ASSY-BTS LIGHT GREY	0.899	Triquest Precision Plastics	Amptech	Barrett Technical Engineering		H	AS
--P0680793				P0680793	1	WALL MOUNT CLIP	ND/NA					H	PT
--P0858093				P0858093	1	FEATURE SET STAND (D GREY)	ND/NA					H	PT
-NT6B9798	6	3	STD	A0373895	1	FEATURE SET KIT-UK	1.384	Quebecor Printimg Inc				H	AS
--NT6B9754	3	1	STD	A0372367	1	FEATURED SET SPARE KEY CAP KIT-UK	ND/NA					H	AS
---P0675883				P0675883	1	KEY CAP - CALL PICKUP NT0B03AA	ND/NA					H	PT
---P0675885				P0675885	1	KEY CAP - CALL FWD NT0B03AA	ND/NA					H	PT
---P0693057				P0693057	1	DESIGNATED KEY CAP LINE 5	ND/NA					H	PT
---P0693058				P0693058	1	DESIGNATED KEY CAP LINE 6	ND/NA					H	PT

--P0693059				P0693059	1	DESIGNATED KEY CAP CONF/TRANS	ND/NA														H	PT
--P0693060				P0693060	1	DESIGNATED KEY CAP VOICE CALL	ND/NA														H	PT
--P0693061				P0693061	1	DSG BUT CAP 'HANDSFREE/MU	ND/NA														H	PT
--P0704242				P0704242	1	KEY CAP "RECALL"	ND/NA														H	PT
--P0705800				P0705800	6	WINDOW KEY CAP - GREEN	ND/NA														H	PT
--P0705801				P0705801	4	WINDOW KEY CAP - MEDIUM GRAY	ND/NA														H	PT
--P0713042				P0713042	1	KEY CAP DESIGNATION "LINE POOL"	ND/NA														H	PT
--P0712985				P0712985	1	DIRECTORY CARD-UK BTS LIGHT GREY	ND/NA														H	PT
--P0714463				P0714463	1	USER CARD-M7310 TELEPHONE UK	ND/NA														H	PT
--P0731895				P0731895	1	BUTTON LABEL CARD-UK	ND/NA														C	
--P0741367				P0741367	1	LENS, DIRECTORY		0.081													H	PT
-NT8B20AG	2	12	STD	A0646654	1	UK FEATURE SET COMMON LEVEL	ND/NA														M	AS
--A0336259				A0336259	1	CONN ELASTOMERIC N/A ARRAY 0.000 PITCH C N/A NA		0.033	244787 (Fujipoly America Co)	005278 (Shin Etsu Polymer America Inc)											H	PT
-NT8B2112	8	MD	MD	A0626305	1	FEATURE SET C84 PCP (bare board)	ND/NA														H	AS
--A0382452				A0382452	1	RES FILM SMT 33.20 KOHM 0.100W 1.00% 100 PPM/C		0.002	000380 (Panasonic Industrial Co Circuit Custom Components)	001096 (AVX Corp)	006715 (Dale Electronics Inc)	006842 (Rohm Electronics)	006840 (Roederstein Electronics Inc)	398199 (Yageo Corporation)							C	CM
--CA07X6C220M035	T			A0337005	1	CAP AL SMD 22.0UF 20.0% 35V 105C 6.80MM SIZE		0.045	000380 (Panasonic Industrial Co Circuit Custom Components)	317739 (Elna America Inc)	041418 (United Chemicon Inc)	088806 (Nichicon America Corp)									C	
--CHC0805C0G102J	5B			A0336709	6	CAP CER CHIP 1.0NF 5.00% 50.0V C0G 0805		0.008	075310 (Syfer Technology Ltd)	008498 (Murata Erie North America Inc)	008494 (Johanson Dielectrics Inc)	005933 (Vitramon Inc)	006879 (TDK Corp)	001096 (AVX Corp)	385727 (EPCOS AG)	398199 (Yageo Corporation)	299803 (Samsung Electro Mechanics)	006892 (Kemet Electronics)	390075 (Taiyo Yuden Inc)		C	
--CHC0805C0G151J	5B			A0326616	2	CAP CER CHIP 150.0PF 5.00% 50.0V C0G 0805		0.009	075310 (Syfer Technology Ltd)		008494 (Johanson Dielectrics Inc)	005933 (Vitramon Inc)	006879 (TDK Corp)	001096 (AVX Corp)	385727 (EPCOS AG)	398199 (Yageo Corporation)	299803 (Samsung Electro Mechanics)	006892 (Kemet Electronics)	390075 (Taiyo Yuden Inc)	006193 (Corning Glass Works)	C	
--CHC0805C0G221J	5B			A0319226	1	CAP CER CHIP 220.0PF +-5.00% 50.0V C0G 0805 NICKEL		0.007	075310 (Syfer Technology Ltd)	008498 (Murata Erie North America Inc)	008494 (Johanson Dielectrics Inc)	005933 (Vitramon Inc)	006879 (TDK Corp)	001096 (AVX Corp)	385727 (EPCOS AG)	398199 (Yageo Corporation)	299803 (Samsung Electro Mechanics)	006892 (Kemet Electronics)	390075 (Taiyo Yuden Inc)	006193 (Corning Glass Works)	C	CM
--CHC0805C0G330J	5B			A0328974	2	CAP, CER, CHIP, 33PF, 5%, 50V, C0G, 0805, NICKEL		0.005	x	x	x	x	x	x	x	x	x	x		x	C	
--CHC0805C0G331J	5B			A0322280	2	CAP CER CHIP 330.0PF 5.00% 50.0V C0G 0805		0.007	x	x	x	x	x	x	x	x	x	x	x	x	C	
--CHC0805C0G471J	5B			A0325379	3	CAP CER CHIP 470.0PF 5.00% 50.0V C0G 0805		0.007	x	x	x	x	x	x	x	x	x	x	x	x	C	
--CHC0805X7R103K	5B			A0322281	7	CAP CER CHIP 10.0NF 10.00% 50.0V X7R 0805		0.009	x	x	x	x	x	x	x	x		x	x		C	
--CHC0805X7R104K	4B			A0378587	6	CAP CER CHIP 100.0NF 10.00% 16.0V X7R 0805 NICKEL		0.015	x	x		x	x	x	x	x	x	x			C	CM
--CHC0805X7R223K	5B			A0329253	1	CAP CER CHIP 22.0NF 10.00% 50.0V X7R 0805 NICKEL		0.011	x	x	x	x	x	x	x	x	x	x	x	x	C	CM
--CHC0805X7R224K	4B			A0385235	7	CAP CER CHIP 220.0NF 10.00% 16.0V X7R 0805 NICKEL		0.032		x		x	x	x			x				C	CM
--CHC0805X7R473J	5B			A0381455	2	CAP, CER, CHIP, 47NF, 5%, 50V, X7R, 0805, NICKEL		0.013	x	x		x	x	x	x		x	x			C	
--CHC1206X7R104K	5B			A0328995	1	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206		0.012	x	x	x	x	x	x	x	x	x	x	x		C	CM
--CHC1210X7R474K	3B			A0381403	1	CAP, CER, CHIP, 470NF, 10%, 25V, X7R, 1210, NICKEL		0.062	x			x	x	x			x				C	
--CHR01A1500				A0326936	2	RES FILM SMT 150.00 OHM 0.125W 1.00% 100 PPM/C		0.002	005319 (State Of The ART Inc)	006715 (Dale Electronics Inc)	001096 (AVX Corp)	000380 (Panasonic Industrial Co Circuit Custom Components)	006840 (Roederstein Electronics Inc)	006842 (Rohm Electronics)	009832 (KOA Speer Electronics Inc)	398199 (Yageo Corporation)					C	CM
--CHR01A90R9				A0325349	2	RES FILM SMT 90.90 OHM 0.125W 1.00% 100 PPM/C		0.002	x	x	x	x	x	x	x	x					C	CM
--CHR01E1002				A0380100	2	RES FILM SMT 10.00 KOHM 0.100W 1.00% 100 PPM/C		0.002		x	x	x	x	x	x	x					C	CM
--CHR01E1003W				A0380943	1	RES FILM SMT 100.00 KOHM 0.100W 1.00% 100 PPM/C		0.002		x	x	x	x	x	x	x					C	CM
--CHR01E1100W				A0384315	1	RES FILM SMT 110.00 OHM 0.100W 1.00% 100 PPM/C		0.002		x	x	x	x	x	x	x					C	CM
--CHR01E1693W				A0602132	7	RES FILM SMT 169.00 KOHM 0.100W 1.00% 100 PPM/C		0.002		x	x	x	x	x	x	x					C	CM
--CHR01E2673W				A0381789	1	RES FILM SMT 267.00 KOHM 0.100W 1.00% 100 PPM/C		0.002		x	x	x	x	x	x	x					C	CM
--CHR01E5111W				A0381782	6	RES FILM SMT 5.11 KOHM 0.100W 1.00% 100 PPM/C		0.002		x	x	x	x	x	x	x					C	CM
--CHR01E5112W				A0381114	1	RES FILM SMT 51.10 KOHM 0.100W 1.00% 100 PPM/C		0.002		x	x	x	x	x	x	x					C	CM
--CHR05A1005				A0315355	1	RES FILM SMT 10.00 MOHM 0.250W 5.00% 200 PPM/C		0.001		x	x			x	x	x					C	CM
--CPP32A10B09				A0293386	1	CONN STR HEADER 2X5 ARRAY 0.100 PITCH AUPD		0.06	004932 (Robinson Nugent Inc)	244115 (Framatome Connectors)											C	
--CRF29D101J				A0383518	1	SURFACE MOUNT CHIP INDUCTOR		0.052		006879 (TDK Corp)	009832 (KOA Speer Electronics Inc)										C	
--CTS10Y1206T1R0	M16			A0376793	2	CAP TAN CHIP 1.0UF 20.00% 16.0V 85C 1206		0.057	031904 (Sprague Electric Co)	006892 (Kemet Electronics)	128661 (AVX Ltd)	000380 (Panasonic Industrial Co Circuit Custom Components)	003799 (Matsuo Electronics)	385727 (EPCOS AG)	088806 (Nichicon America Corp)						C	
--CTS10Y1206T2R2	K10			A0376729	1	CAP TAN CHIP 2.2UF 10.00% 10.0V 85C 1206		0.061	x	x	x	x	x	x	x	252695 (NIC Components Corp)					C	CM
--CTS10Y1311T100	M06			A0376730	5	CAP TAN CHIP 10.0UF 20.00% 6.3V 85C 1311		0.075	x	x	x	x	x	306066 (NEC Electronics Inc)	x						C	CM
--NPS25028L181				A0600541	1	CONN TELEDAPT TEL ARRAY 0.040 PITCH AUPD FEMALE ST		0.362	244115 (Framatome Connectors)												C	CM
--NT8B2154	2	MD	MD	A0636857	1	C84 PWB	ND/NA														H	AS
--NTT407CL				A0609057	1	XFMR PULSE THRU-HOLE 2 OUTPUTS		0.51	006623 (Pulse Engineering Inc)												C	
--QD-BAV99				A0263806	7	DIODE, SWITCHING, DUAL, 70V 0.25A SMD		0.016	004502 (Philips Components)	332828 (Zetex Inc)	360872 (Infineon Technologies Corp)	370624 (ON Semiconductor Semiconductor Components Ind L)	006842 (Rohm Electronics)	317654 (General Semiconductor Inc)	312182 (Fairchild Semiconductor)						C	CM

--QD-MMBD7000				A0351182	4	DIO DUAL 100V 0.2A SURFACE		0.019	004502 (Philips Components)	332828 (Zetex Inc)		370624 (ON Semiconductor Semiconductor Components Ind L)			312182 (Fairchild Semiconductor)						C	
--QD-SMBJ22A				A0383931	1	DIO TRANSIENT SUPPRESS 600W 22VRM 35.5VCL SMD		0.116	049650 (Rectron USA)	408817 (Micro Commercial Components Corp)	005117 (STMicroelectronics Incorporated)	370624 (ON Semiconductor Semiconductor Components Ind L)	003943 (Microsemi Corp)	214349 (Semitron Industries Ltd)	317654 (General Semiconductor Inc)						C	CM
--QMV362AH5				A0369512	1	IC CUSTOM MICRO CIRCUIT INTERNAL (SM)		1.08	006848 (Nortel Networks Corporation Nortel 051Nortel Semiconductor)												C	
--QMV755AT5				A0620675	1	C84, CUSTOM ASIC, DGITAL TERMINAL INTERFACE, PLCC4	ND/NA		005117 (STMicroelectronics Incorporated)												C	CM
--XT75P1HHATS-S-	10			A0367203	1	CRYSTAL QUARTZ 10.244MHZ (SM)		0.27	016165 (Mtron Industries Inc)	231898 (CTS Corporation Frequency Control Division)	005867 (Valpey Fisher Corp)	108322 (Saronix)	026425 (C-MAC Quartz Crystals Ltd)	057492 (Toyocom USA Inc)							C	CM
-NTAB1359	2	1	STD	A0617914	1	MICROPHONE & TUBE ASSEMBLY		0.49													M	AS
--P0845106				P0845106	1	BOOT, MICROPHONE - 2008 HF (MOLDED RUBBER)	ND/NA														H	PP
--QUAG11C				A0605642	1	MICROPHONE ELECTRET OMNIDIREC TERMINALS: WIRE LE	ND/NA		004646 (Primo Microphone Inc)												C	
-NTAB1428	6	2	STD	A0626540	1	LCD ASSEMBLY FEATURE SET	ND/NA														H	AS
--CEL01C010				A0609735	1	CONN ELASTOMERIC N/A ARRAY 0.004 PITCH C N/A NA		0.18	005278 (Shin Etsu Polymer America Inc)												C	
--NT6B58AN	2	1	STD	A0409641	0	NORSTAR GLOBAL SETS FIRMWARE															F	FW
--NT8B2023	1	1	DEV	A0748437	1	NORSTAR FEATURE MYLAR	ND/NA														M	AS
--P0739654				P0739654	1	LCD BEZEL (moulded plastic)		0.161													C	
--P0857197				P0857197	1	LCD COMPRESSION GASKET		0.068													M	PT
--QDLC39ATC2X16				A0383574	1	LCD 2X16 DOT MATRIX GLASS ONLY		0.696	202097 (Seiko Instruments Inc LCD Manufacturing Factory)	202095 (Sanyo Semiconductor Corp)											C	
--QMS-M37510E6Z5	06BVR			A0615869	1	PROGRAMMED DEVICE		4.35													S	SA
--P0601534				P0601534	7	TAPPING SCREW, PLASTITE, 60 DEGREES, SINGLE LEAD,		0.009	003238 (Irwin Industrial Agencies Ltd)	000403 (Process Products Ltd)	207658 (Elco Industries Inc)										C	
--P0679592				P0679592	1	SPEAKER FOAM		0.104													H	PT
--P0691802				P0691802	4	TYPE B PAN HEAD CR 1A 0.112-24X 0.312, S, 289A		0.004	000528 (Townsend)	000403 (Process Products Ltd)											C	CM
--P0696760				P0696760	1	LS06C050 TYPE SPEAKER WITH LEADS, Z = 50 OHMS, FR		0.966	007339 (Stetron Int Inc)												H	PT
--QDLC10A				A0336289	1	LCD, TN, 2 X 5 TRIANGLE INDICATOR, GLASS ONLY		0.84	202095 (Sanyo Semiconductor Corp)	202096 (Samsung Electron Devices Co Ltd)	292207 (Picvue Electronics Ltd)	086315 (Philips Hong Kong Ltd)									C	
-NTAB1715-93	1	1	STD	A0646283	1	UK FEATURE SET COVER ASS'Y DOL GREY		6.832	Amptech												H	AS
--A0336169				A0336169	1	ELASTOMERIC KEYPAD FOR FEATURED KEY USE	ND/NA		047658 (Toho Polymer Co Ltd)	005278 (Shin Etsu Polymer America Inc)											C	
--NPS25176-20L4				A0601564	1	ELASTOMER, FEATURE KEYS (FEATURE SET) A NEW VERSI	ND/NA		005278 (Shin Etsu Polymer America Inc)												C	CM
--NPS25176-22L4				A0601565	1	ELASTOMER, SQUARE/FEATURE SET DIALPADA NEW VERSION	ND/NA														C	
--NT8B9743	4	2	STD	A0372212	1	FEATURE SET SUPER PLUCKER-UK	ND/NA														H	AS
--P0644105				P0644105	1	HOLD KEY CAP NT0B02AA	ND/NA														H	PT
--P0665362				P0665362	1	RLS BUTTON STUD	ND/NA														H	PT
--P0665364				P0665364	1	DSG. BUTTON CAP "RLS"	ND/NA		030194 (Caprock Manufacturing)												H	PT
--P0675855				P0675855	1	KEY CAP - ALL PAGE NT0B03AA	ND/NA														H	PT
--P0675878				P0675878	2	KEY CAP - INTERCOM NT0B03AA	ND/NA														H	PT
--P0675879				P0675879	1	KEY CAP - FEATURE NT0B03AA	ND/NA														H	PT
--P0680935				P0680935	1	SHIFT BUTTON (NT8B04AA)	ND/NA														H	PT
--P0681035				P0681035	3	SOFTKEY BUTTON (NT8B)	ND/NA														H	PT
--P0687376				P0687376	1	LAST NUMBER KEY CAP	ND/NA														H	PT
--P0693053				P0693053	1	DESIGNATED KEY CAP LINE 1	ND/NA														H	PT
--P0693054				P0693054	1	DESIGNATED KEY CAP LINE 2	ND/NA														H	PT
--P0693055				P0693055	1	DESIGNATED KEY CAP LINE 3	ND/NA														H	PT
--P0693056				P0693056	1	DESIGNATED KEY CAP LINE 4	ND/NA														H	PT
--P0693063				P0693063	1	DESIGNATED KEY CAP DND	ND/NA														H	PT
--P0693065				P0693065	1	DESIGNATED KEY CAP SPEED DIAL	ND/NA														H	PT
--P0705801				P0705801	12	WINDOW KEY CAP - MEDIUM GRAY		0.016													H	PT
--P0715353				P0715353	12	DSS LABEL BUTTON COVER(LIP LESS)		0.013													C	
--P0727456				P0727456	1	DIAL KEY TREE		0.41													C	
--P0727457				P0727457	12	KEY STUD		0.015													C	
-P0643236				P0643236	1	HOOKSWITCH RETURN		0.012													H	PT
-P0693094				P0693094	1	LCD LENS (FEATURE)		0.453													H	PT
-P0731633				P0731633	1	BRANDMARK PLATE-BTS LIGHT GREY-UK		0.095													H	PT
-P0736489				P0736489	1	DSS BACK PLATE		0.095													C	
-P0739768				P0739768	1	HOOKSWITCH PLUNGER	ND/NA														C	
-P0742335				P0742335	1	LENS, FEATURE SET		0.225													C	
-P0745099				P0745099	1	HOOKSWITCH DOME		0.05													H	PT
-P1002493				P1002493	1	FEATURE SET - BASE		1.242													C	
-P1004193				P1004193	1	FEATURE SET COVR	ND/NA														C	
-P0714709				P0714709	1	PLASTIC BAG NORSTAR SETS		0.014	036157 (M PAK Plastics Ltd)												H	PP
-P0741929				P0741929	1	BLANK PACKAGE LABEL		0.007	134961 (Precision Label Ltd)												H	PT

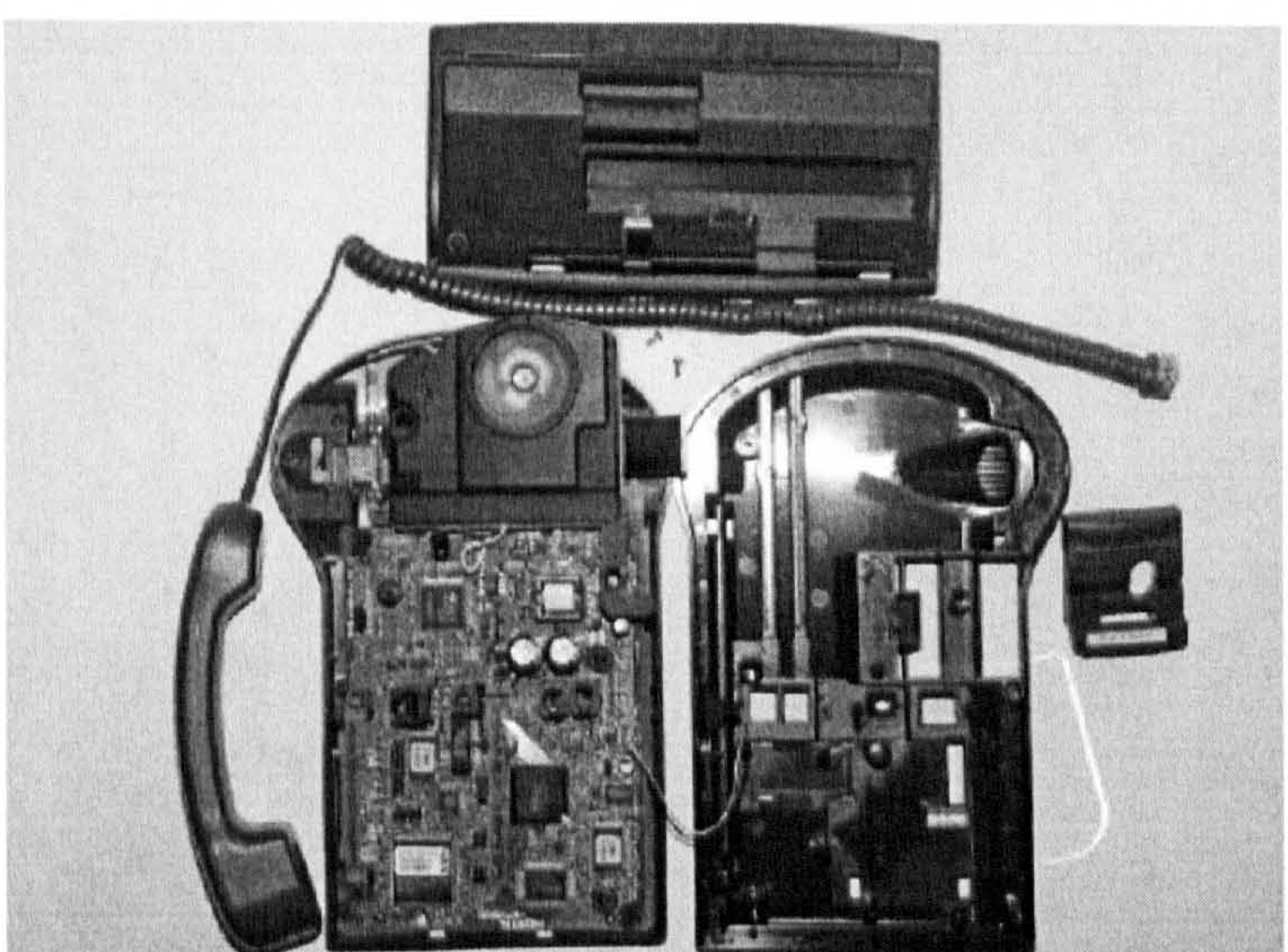
-P0800596				P0800596	1	BLANK SERIAL LABEL - NORSTAR	0.019	134981 (Precision Label Ltd).												H	PT

Appendix XIII.

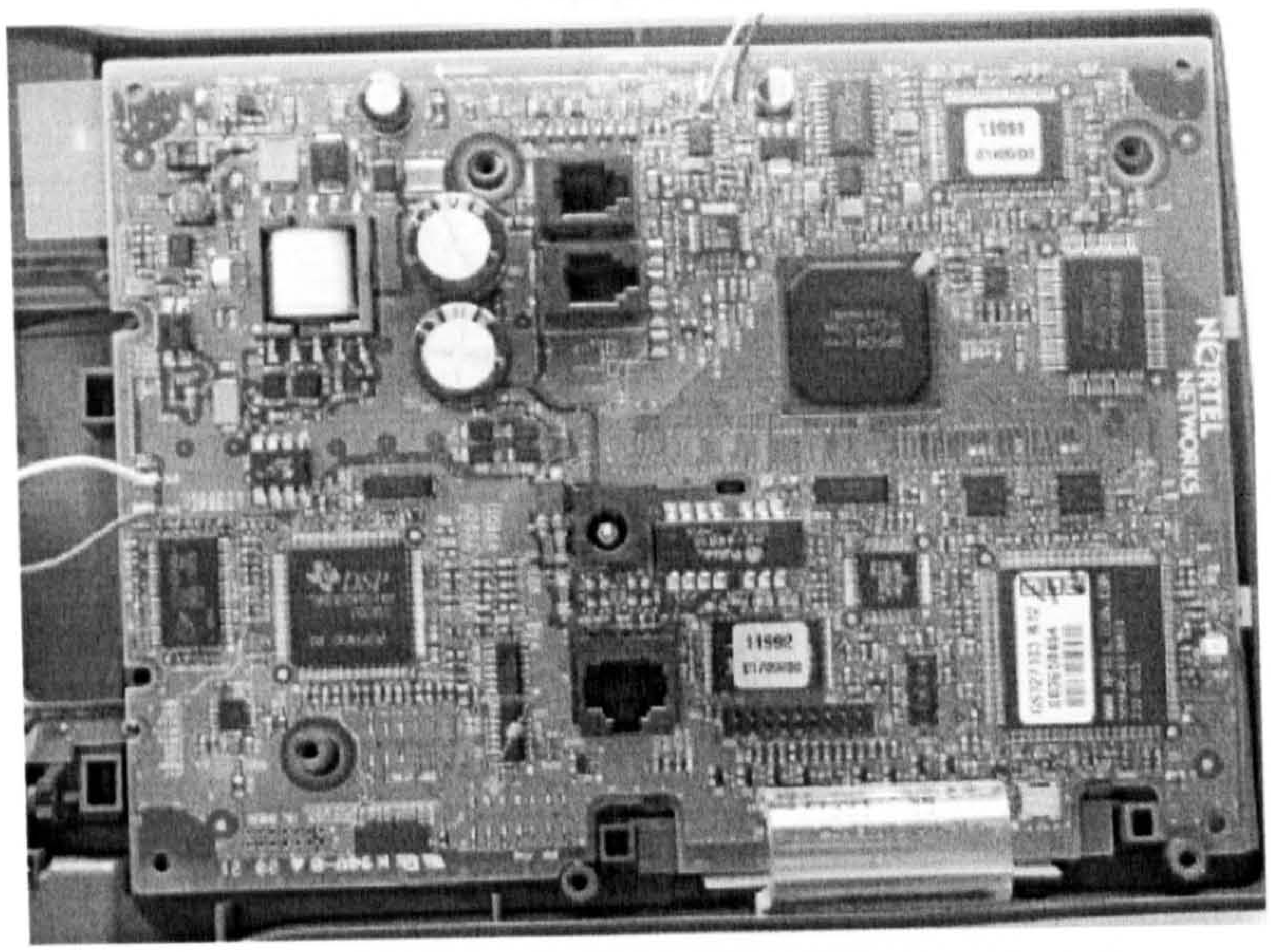
i2004 Phone Images

Appendix XIII. Images of i2004

i2004 Telephone Front View



i2004 Telephone All Parts



i2004 Telephone PCB

Appendix XIV.

i2004 Phone Bill of Materials

Appendix XIV BoM of i2004

CPC	Qty	Title	Cost (US$)	Supplier 1 (from NAFTA Aus file)	Supplier 2	Supplier 3																
....	...	....																				
B0253074		ETHERPHONE (TWO TONE)																				
A0648375	1	CAT 5 PATCH CORD 7FT, RJ-45 PLUGS WIRED 1-1, 2-2,	2.64	EXCELTEK ELECTRONICS (HK) LTD	007051 (Anixter Inc), PN: L5-0822-09-7, Not fully assessed	292679 (Nordx CDT Inc), PN: 23598077, Not fully assessed																
A0783032	1	TRANSDUCER, TRANSMITTER, ELECTRET, DIRECTIVITY (OM	0.4403	SENKO SANGYO CO LTD	Panasonic Industrial Co Circuit Custom Components																	
A0788682	1	HANDSET CORD, ETHER GRAY MATTE, 4 COND, 4 POS, 2.7	0.5622	EXCELTEK ELECTRONICS (HK) LTD	Adirondack Wire & Cable	ACS?																
A0619627	1	AC TO AC, DIRECT PLUG-IN, 8W, 120 VAC, 50/60 HZ, T	1.6099	AULT INC	Taimic Electric Co Ltd	Anoma Electric Co Ltd	Sino American Electronic Co Ltd															
P0904881	2	FLEXIBLE MYLAR PCB	0.2026	POLYFLEX CIRCUITS INC																		
B0253860	1	ELASTOMERIC KEYPAD/KEYCAP ASSY, MAIN	2.6097	ICHIA TECHNOLOGIES																		
P0904683	1	ELASTOMETIC KEYPAD, MAIN																				
P0906339	2	BI-DIRECTIONAL ARROW KEYCAP, (LEFT/RIGHT)																				
P0906340	1	UP ARROW KEYCAP																				
P0906341	1	DOWN ARROW KEYCAP																				
P0906343	4	SOFTKEY KEYCAP																				
P0906349	2	VOICE DIAL AND MUTE LIGHTPIPE																				
P0906470	1	VOICE DIAL KEYCAP																				
P0906471	1	DIRECTORY KEY (ICON)																				
P0906472	1	INBOX KEYCAP																				
P0906473	1	OUTBOX KEYCAP																				
P0906474	1	SERVICES KEYCAP																				
P0906475	1	EXPAND KEYCAP																				
P1035301	1	MUTE KEY																				
P1035322	1	QUIT/COPY KEYS																				
P1035323	1	COPY KEY (ICON)																				
P1035364	1	HOLD KEY (ICON)																				
P1035365	1	GOODBYE KEY (ICON)																				
B0258659	1	ELASTOMERIC KEYPAD/KEYCAP ASSY, HANDS FREE	2.6097																			
P0904728	1	ELASTOMERIC KEYPAD, HANDSFREE																				
P1053082	1	KEY, MOLDED, PRINTED, HANDSFREE																				
B0253858	1	LCD/PCA CARRIER ASSY																				
B0254531	1	ETHERNET 2 PCA (FOR ETHERPHONE)																				
A0694318	2	RES CHIP THICK FILM 33.0 5% .1W +/-200PPM/C	0.0037	AVNET - USD ACCOUNT	Dale Electronics Inc	Roederstein Electronics Inc	AVX Corp	Rohm Electronics	KOA Speer Electronics Inc	TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	ARROW ELECTRONICS (SMDB)										
A0696327	5	BEAD,FERRITE CHIP 220OHM @100MHZ 200MA .3OHM DCR	0.1405	AVNET - USD ACCOUNT	Murata Erie North America Inc	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)															
A0337005	1	CAP AL SMD 22.0UF 20.0% 35V 105C 6.80MM SIZE	0.066	REC ELECTRONICS (YEN ACCOUNT)	Panasonic Industrial Co Circuit Custom Components	Elna America Inc	United Chemicon Inc	Nichicon America Corp	ARROW ELECTRONICS (SMDB)	GC COMPONENTS (SMDB)	ACAL ELECTRONICS LIMITED (SMDB)	YOUNG ECC ELECTRONICS (SMDB)	QUALCOMM INCORPORATED (SMDB)	DIGIKEY CORPORATION (SMDB)								
A0627002	1	CAP AL RL 100.0UF 20% 35.0V 105C 3.5MM SPAN	0.0524	CAPTRON PTY. LIMITED	United Chemicon Inc	Nichicon America Corp	TTI INCORPORATED (SMDB)															
A0774171	2	CAP AL RL 470.0UF 20% 63.0V 105C 7.5MM SPAN	0.49	AVNET - USD ACCOUNT	Nichicon America Corp																	
A0248717	1	CAP CER AX 0.01UF 50V 10%	0.0183	AVNET - USD ACCOUNT	AVX Avio Excelente SA DE CV	Kemet Electronics	BC Components	ARROW ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)													
A0365057	1	CAP CER CHIP 100.0PF 5.00% 50.0V C0G 0603 NICKEL	0.005	AVNET - USD ACCOUNT	Yageo Corporation	Vitramon Inc	AVX Corp	TDK Corp	Murata Erie North America Inc	Samsung Electro Mechanics	Kemet Electronics	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	FUTURE ELECTRONICS (SMDB)	SOLECTRON CORPORATION (SMDB)	PASSIVE COMPONENTS INC (SMDB)						
A0353256	3	CAP CER CHIP 100PF 50V 10%	0.0164	SOANAR LIMITED USD	Taiyo Yuden Inc	TDK Corp	Murata Erie North America Inc	Johanson Dielectrics Inc	Vitramon Inc	AVX Corp	EPCOS AG	Syfer Technology Ltd	Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	TTI INCORPORATED (SMDB)						
A0601112	1	CAP CER CHIP 150.0PF +-5.00% 50.0V C0G 0603 NICKEL	0.0082	REC ELECTRONICS (USD ACCOUNT)		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp			Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	VISHAY INTERTECHNOLOGY INC (SMDB)	ARROW ELECTRONICS (SMDB)	SCI Systems Inc (SMDB)				
A0365048	2	CAP, CER, CHIP, 20PF, 5%, 50V, C0G, 0603, NICKEL	0.01	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp				Samsung Electro Mechanics	SEMISPECIALISTS OF AMERICA INCORPORATED (SMDB)							
A0365049	2	CAP CER CHIP 22.0PF +-5.00% 50.0V C0G 0603 NICKEL	0.012	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp			Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	TTI INCORPORATED (SMDB)	CONNECT ELECTRONICS LIMITED (SMDB)	CANADIAN SOURCE CORP (SMDB)				
A0365053	2	CAP CER CHIP 33.0PF +-5.00% 50.0V C0G 0603 NICKEL	0.0099	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp	EPCOS AG	Syfer Technology Ltd	Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	ARROW ELECTRONICS (SMDB)	FUTURE ELECTRONICS (SMDB)					
A0365054	2	CAP, CER, CHIP, 47PF, 5%, 50V, C0G, 0603, NICKEL	0.0119	SOANAR LIMITED USD		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp			Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	ARROW ELECTRONICS (SMDB)						
A0353259	22	CAP CER CHIP 1.0NF 10.00% 50.0V X7R 0603 NICKEL		DELTA ELECTRICAL GROUP PTY LTD		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp	EPCOS AG	Syfer Technology Ltd	Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	ARROW ELECTRONICS (SMDB)	CONNECT ELECTRONICS LIMITED (SMDB)	SEMISPECIALISTS OF AMERICA INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0353467	11	CAP CER CHIP 10.0NF 10.00% 50.0V X7R 0603 NICKEL	0.0602	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp			Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	ARROW ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	SOLECTRON CORPORATION (SMDB)	CELESTICA INCORPORATED (SMDB)	SCI SYSTEMS INC (SMDB)	
A0618849	61	CAP CER CHIP 100.0NF 10.00% 16.0V X7R 0603 NICKEL	0.8196	FUTURE ELECTRONICS INC		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp				Samsung Electro Mechanics		ARROW ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	SOLECTRON CORPORATION (SMDB)	FREEWAY ELECTRONICS (SMDB)		
A0365063	1	CAP, CER, CHIP, 2.2 NF, 10%, 50V, X7R, 0603, NICKE	0.0065	SOANAR LIMITED USD		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp				Samsung Electro Mechanics	Kemet Electronics	ARROW ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	SCI SYSTEMS INC (SMDB)	AVNET INC (SMDB)		
A0353260	2	CAP, CER, CHIP, 3.3NF, 10%, 50V, X7R, 0603, NICKEL	0.014	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp			Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	ARROW ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	SCI SYSTEMS INC (SMDB)	MAGNUM ELECTRIC CORPORATION (SMDB)		
A0619613	1	CAP CER CHIP 33.0NF 10.00% 16.0V X7R 0603 NICKEL	0.0144	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp		Syfer Technology Ltd		Samsung Electro Mechanics			TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	FUTURE ELECTRONICS (SMDB)	MAGNUM ELECTRIC CORPORATION (SMDB)		
A0368142	1	CAP CER CHIP 470.0PF 10.00% 50.0V X7R 0603	0.005	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp			Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics	ARROW ELECTRONICS (SMDB)		VISHAY INTERTECHNOLOGY INC (SMDB)				

A0385067	1	CAP CER CHIP 560.0PF +-10.00% 50.0V X7R 0603 NICKE	0.0077	AVNET - USD ACCOUNT		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp				Samsung Electro Mechanics								
A0774039	2	CAP CER CHIP 330.0NF 80.00% 16.0V Y5V 0603 NICKEL	0.0658	AVNET - USD ACCOUNT					Vitramon Inc	AVX Corp						SOURCE MARKETING INTERNATIONAL (SMDB)	PC COMPONENTS LIMITED (SMDB)	SCI SYSTEMS INC (SMDB)				
A0609005	2	CAP CER CHIP 100.0NF 10.00% 25.0V X7R 0805 NICKEL	0.0313	AVNET - USD ACCOUNT		TDK Corp	Samsung Electro Mechanics		Vitramon Inc	AVX Corp	EPCOS AG	Syfer Technology Ltd		Samsung Electro Mechanics	Kemet Electronics	TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	FUTURE ELECTRONICS (SMDB)	ARROW ELECTRONICS (SMDB)	SOLECTRON CORPORATION (SMDB)	REAL WORLD THE TECHNOLOGY TRADING CO (SMDB)	CELESTICA INCORPORATED (SMDB)
A0771920	1	CAP CER CHIP 1.0UF 10.00% 10.0V X7R 0805 NICKEL	0.065	REC ELECTRONICS (USD ACCOUNT)						AVX Corp					Kemet Electronics	TTI INCORPORATED (SMDB)		AVNET INC (SMDB)	ARROW ELECTRONICS (SMDB)	SCI SYSTEMS INC (SMDB)	SEMISPECIALISTS OF AMERICA INCORPORATED (SMDB)	PV TRON (SMDB)
A0385112	1	CAP, CER, CHIP, 22 NF, 20%, 50V, X7R, 0805, NICKEL	0.0112	AVNET - USD ACCOUNT		TDK Corp	Samsung Electro Mechanics		Vitramon Inc	AVX Corp		Syfer Technology Ltd	Yageo Corporation	Samsung Electro Mechanics	Kemet Electronics							
A0725241	1	CAP CER CHIP 220.0NF 10.00% 25.0V X7R 0805 NICKEL	0.045	AVNET - USD ACCOUNT		TDK Corp				AVX Corp		Syfer Technology Ltd				TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	TOP CHIP CORPORATION (SMDB)	ARROW ELECTRONICS (SMDB)	AMERICA II ELECT (SMDB)	MIT DISTRIBUTORS INCORPORATED (SMDB)	JABIL CIRCUIT INC (SMDB)
A0773610	2	CAP CER CHIP 4.7UF 80.00% 10.0V Y5V 0805 NICKEL	0.2025	REC ELECTRONICS (USD ACCOUNT)	Taiyo Yuden Inc					AVX Corp						RAND WORLDWIDE (SMDB)	CONNECT ELECTRONICS LIMITED (SMDB)					
A0680472	2	CAP CER CHIP 10.0UF 20.00% 6.3V X5R 1206 NICKEL		?		TDK Corp	Murata Erie North America Inc			AVX Corp									ARROW ELECTRONICS (SMDB)			
A0379519	2	CAP CER CHIP 100.0NF 10.00% 100.0V X7R 1206 NICKEL	0.0348	BRAEMAC - USD ACCOUNT		TDK Corp			Vitramon Inc	AVX Corp		Syfer Technology Ltd	Yageo Corporation	Samsung Electro Mechanics		TTI INCORPORATED (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	ARROW ELECTRONICS (SMDB)	FUTURE ELECTRONICS (SMDB)	SCI SYSTEMS INC (SMDB)		
A0648268	5	CAP CER CHIP 1.0UF 10.00% 16.0V X7R 1206 NICKEL	0.2316	DELTA ELECTRICAL GROUP PTY LTD		TDK Corp	Murata Erie North America Inc		Vitramon Inc	AVX Corp		Syfer Technology Ltd		Samsung Electro Mechanics		TTI INCORPORATED (SMDB)	CELESTICA INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	SOLECTRON CORPORATION (SMDB)	SCI SYSTEMS INC (SMDB)	CANADIAN SOURCE CORP (SMDB)	MARLBOROUGH ELECTRONIC SYSTEMS (SMDB)
A0686755	1	CAP CER CHIP 2.2UF 10.00% 25.0V X7R 1210 NICKEL	0.1549	SOANAR LIMITED USD		TDK Corp				AVX Corp							CELESTICA INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)				
A0739666	1	CAP CER CHIP 1.0NF 10.00% 2000.0V X7R 1808 NICKEL	0.1944	AVNET - USD ACCOUNT						AVX Corp		Syfer Technology Ltd										
A0792773	1	CAP CER CHIP 5.6NF 20.00% 2500.0V X7R 1825 NICKEL	0.7961	AVNET - USD ACCOUNT						AVX Corp								ARROW ELECTRONICS (SMDB)				
A0291506	1	RES FILM SMT 1.10 KOHM 0.125W 1.00% 100 PPM/C	0.0032	PHILIPS COMPONENTS USD	State Of The ART Inc	AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation					VISHAY INTERTECHNOLOGY INC (SMDB)	ARROW ELECTRONICS (SMDB)				
A0315302	1	RES FILM SMT 2.43 KOHM 0.125W 1.00% 100 PPM/C	0.0034	AVNET - USD ACCOUNT	State Of The ART Inc	AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation					SND ELECTRONICS (SMDB)	ARROW ELECTRONICS (SMDB)				
A0602153	1	RES FILM SMT 11.30 KOHM 0.100W 1.00% 100 PPM/C	0.0019	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation										
A0382454	1	RES FILM SMT 475.00 KOHM 0.100W 1.00% 100 PPM/C	0.0019	PARTMINER UK LTD. (USD)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation				TTI INCORPORATED (SMDB)	SND ELECTRONICS (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0381778	4	RES FILM SMT 49.90 OHM 0.100W 1.00% 100 PPM/C	0.0106	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc											
A0382344	1	RES FILM SMT 51.10 OHM 0.100W 1.00% 100 PPM/C	0.0019	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc				CELESTICA INCORPORATED (SMDB)	TTI INCORPORATED (SMDB)	QUALCOMM INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0382485	1	RES FILM SMT 750.00 KOHM 0.100W 1.00% 100 PPM/C	0.0027	PHILIPS COMPONENTS USD		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation							VISHAY INTERTECHNOLOGY INC (SMDB)			
A0602366	1	RES FILM SMT 909.00 KOHM 0.100W 1.00% 100 PPM/C	0.0023	PHILIPS COMPONENTS USD		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation					MAGNUM ELECTRIC CORPORATION (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609545	15	RES FILM SMT 100.00 OHM 0.062W 1.00% 100 PPM/C	0.0385	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc				SCI SYSTEMS INC (SMDB)	REAL WORLD THE TECHNOLOGY TRADING CO (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0382464	8	RES FILM SMT 1.00 KOHM 0.062W 1.00% 100 PPM/C	0.0212	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc				SCI SYSTEMS INC (SMDB)	DEPENDABLE COMPONENT SUPPLY CORP (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609662	42	RES FILM SMT 10.00 KOHM 0.062W 1.00% 100 PPM/C	0.1113	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation			SCI SYSTEMS INC (SMDB)	CELESTICA INCORPORATED (SMDB)		ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0382477	5	RES FILM SMT 100.00 KOHM 0.062W 1.00% 100 PPM/C	0.0099	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc		KOA Speer Electronics Inc		NIC Components Corp		SCI SYSTEMS INC (SMDB)		TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609410	18	RES FILM SMT 121.00 OHM 0.062W 1.00% 250 PPM/C	0.0566	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc					SOLECTRON CORPORATION (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609404	1	RES FILM SMT 1.30 KOHM 0.062W 1.00% 250 PPM/C	0.0019	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						PC COMPONENTS LIMITED (SMDB)	ARROW ELECTRONICS (SMDB)				
A0609401	1	RES FILM SMT 150.00 OHM 0.062W 1.00% 250 PPM/C	0.0055	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0773372	6	RES FILM SMT 1.69 KOHM 0.062W 1.00% 100 PPM/C	0.0159	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc				KOA Speer Electronics Inc						NETWORK GROUP (SMDB)					
A0641481	11	RES FILM SMT 169.00 KOHM 0.062W 1.00% 250 PPM/C	0.0293	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						FREEWAY ELECTRONICS (SMDB)	DEPENDABLE COMPONENT SUPPLY CORP (SMDB)				

A0382465	1	RES FILM SMT 1.78 KOHM 0.062W 1.00% 250 PPM/C	0.0022	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation										
A0634317	1	RES FILM SMT 18.20 KOHM 0.062W 1.00% 250 PPM/C	0.002	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc					CLASSIC COMPONENTS SUPPLY INCORPORATED (SMDB)	FREEWAY ELECTRONICS (SMDB)	MAGNUM ELECTRIC CORPORATION (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0679153	2	RES FILM SMT 1.96 KOHM 0.062W 1.00% 250 PPM/C	0.0039	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc		Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc								VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609392	1	RES FILM SMT 2.00 KOHM 0.062W 1.00% 100 PPM/C	0.0085	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc					SCI SYSTEMS INC (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609387	3	RES FILM SMT 2.21 KOHM 0.062W 1.00% 250 PPM/C	0.0086	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0628567	1	RES FILM SMT 23.700 KOHM 0.062W 1.00% 250 PPM/C	0.0019	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc					PC COMPONENTS LIMITED (SMDB)	TTI INCORPORATED (SMDB)	FUTURE ELECTRONICS (SMDB)		SEMISPECIALISTS OF AMERICA INCORPORATED (SMDB)		
A0773373	1	RES FILM SMT 27.40 KOHM 0.062W 1.00% 100 PPM/C	0.0029	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc				KOA Speer Electronics Inc											
A0609357	2	RES FILM SMT 43.20 KOHM 0.062W 1.00% 250 PPM/C	0.0044	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						ARROW ELECTRONICS (SMDB)	MAGNUM ELECTRIC CORPORATION (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609354	5	RES FILM SMT 4.75 KOHM 0.062W 1.00% 250 PPM/C	0.0093	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc					AVNET INC (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0732607	1	RES FILM SMT 4.99 KOHM 0.062W 1.00% 100 PPM/C	0.0019	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc		Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						TTI INCORPORATED (SMDB)		VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609350	1	RES FILM SMT 51.10 KOHM 0.062W 1.00% 100 PPM/C	0.0026	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0635532	8	RES FILM SMT 51.10 OHM 0.062W 1.00% 250 PPM/C	0.0215	AVNET - USD ACCOUNT	Vishay Resistive Systems	AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc							ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609436	1	RES FILM SMT 56.20 KOHM 0.062W 1.00% 250 PPM/C	0.0027	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc					SEMISPECIALISTS OF AMERICA INCORPORATED (SMDB)	TTI INCORPORATED (SMDB)	FREEWAY ELECTRONICS (SMDB)	TARGET ELECTRONICS INCORPORATED (SMDB)			
A0609432	1	RES FILM SMT 681.00 OHM 0.062W 1.00% 250 PPM/C	0.0026	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc								VISHAY INTERTECHNOLOGY INC (SMDB)			
A0609428	2	RES FILM SMT 750.00 OHM 0.062W 1.00% 100 PPM/C	0.0051	REC ELECTRONICS (USD ACCOUNT)		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc							ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0617546	5	RES FILM SMT 75.00 OHM 0.062W 1.00% 250 PPM/C	0.0196	SENKO SANGYO CO LTD		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						JACO ELECTRONICS INC (SMDB)	ARROW ELECTRONICS (SMDB)				
A0609422	1	RES FILM SMT 8.25 KOHM 0.062W 1.00% 100 PPM/C	0.0022	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc							ARROW ELECTRONICS (SMDB)				
A0353129	1	RES FILM SMT 15.00 OHM 0.063W 5.00% 200 PPM/C	0.0052	SENKO SANGYO CO LTD		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc											
A0382920	2	RES FILM SMT 39.00 OHM 0.063W 5.00% 200 PPM/C	0.0072	AVNET - USD ACCOUNT		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc						SCI SYSTEMS INC (SMDB)	ARROW ELECTRONICS (SMDB)				
A0600431	17	RES FILM SMT 0.05 OHM MAXIMUM 1A MAXIMUM	0.0317	SENKO SANGYO CO LTD		AVX Corp	Dale Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Roederstein Electronics Inc	Rohm Electronics	KOA Speer Electronics Inc	Yageo Corporation				AVNET INC (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0668224	2	RES FILM SMT 5.10 OHM 0.063W 1.00% 500 PPM/C	0.0058	MAYER KRIEG & CO					Roederstein Electronics Inc		KOA Speer Electronics Inc	Yageo Corporation										
A0773304	1	CONN STR HEADER 2X5 ARRAY 0.100 PITCH AU	0.4248	AVNET - USD ACCOUNT	Framatome Connectors																	
A0773303	1	CONN STR HEADER 2X10 ARRAY 0.100 PITCH AU	0.2629	AVNET - USD ACCOUNT	Framatome Connectors																	
A0363518	1	SURFACE MOUNT CHIP INDUCTOR	0.0818	AVNET - USD ACCOUNT	TDK						KOA Speer Electronics Inc					FUTURE ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	PC COMPONENTS LIMITED (SMDB)	RAND WORLDWIDE (SMDB)	SG INDUSTRIES (SMDB)		
A0647041	4	CAP TAN CHIP 10.0UF 20.00% 6.3V 85C 1206	0.4667	AVNET - USD ACCOUNT	NIC Components Corp	Sprague Electric Co	AVX Ltd	Kemet Electronics								FUTURE ELECTRONICS (SMDB)	SCI SYSTEMS INC (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0600342	3	CAP TAN CHIP 10.0UF 10.00% 16.0V 85C 1311	0.3496	AVNET - USD ACCOUNT	NIC Components Corp	NEC Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Kemet Electronics	AVX Ltd	Nichicon America Corp	Sprague Electric Co			CORE COMPONENTS INC (SMDB)	EOI ELECTRONICS INCORPORATED (SMDB)	FUTURE ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	AVX KYOCERA (SMDB)	AVL COMPONENTS INTERNATIONAL (SMDB)	CLASSIC COMPONENTS SUPPLY INCORPORATED SMDB)
A0610069	1	CAP TAN CHIP 22.0UF 10.00% 6.3V 85C 1311	0.1018	ARROW USD ACCOUNT	NIC Components Corp	NEC Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Kemet Electronics	AVX Ltd		Sprague Electric Co				SCI SYSTEMS INC (SMDB)	FUTURE ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	PC COMPONENTS LIMITED (SMDB)		
A0329217	1	CAP TAN CHIP 2.2UF 10.00% 20.0V 85C 1311	0.1155	REC ELECTRONICS (USD ACCOUNT)	NIC Components Corp	NEC Electronics Inc	Matsuo Electronics	Kemet Electronics	EPCOS AG	Nichicon America Corp	AVX Ltd							ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)			
A0783436	1	CAP TAN CHIP 33.0UF 10.00% 10.0V 85C 1311	0.1006	AVNET - USD ACCOUNT						Sprague Electric Co	AVX Ltd			CLASSIC COMPONENTS SUPPLY INCORPORATED (SMDB)								

A0743336	1	CAP TAN CHIP 330.0UF 10.00% 10.0V 85C 2824	0.9369	AVNET - USD ACCOUNT							AVX Ltd			DEPENDABLE COMPONENT SUPPLY CORP (SMDB)		FUTURE ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	CELESTICA INCORPORATED (SMDB)	SOLECTRON CORPORATION (SMDB)	TOP CHIP CORPORATION (SMDB)
A0639979	1	CAP TAN CHIP 100.0UF 10.00% 10.0V 85C 2917 LOW ESR	0.7586	REC ELECTRONICS (USD ACCOUNT)				Kemet Electronics	EPCOS AG	Sprague Electric Co	AVX Ltd											
A0621792	1	CAP TAN CHIP 47.0UF 10.00% 16.0V 85C 2917	0.1997	REC ELECTRONICS (USD ACCOUNT)	NIC Components Corp	NEC Electronics Inc	Panasonic Industrial Co Circuit Custom Components	Kemet Electronics	EPCOS AG	Sprague Electric Co	AVX Ltd			CORE COMPONENTS INC (SMDB)		FUTURE ELECTRONICS (SMDB)	TTI INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	VISHAY INTERTECHNOLOGY INC (SMDB)	RAND WORLDWIDE (SMDB)	AVL COMPONENTS INTERNATIONAL (SMDB)	WESCAR CORP (SMDB)
A0351242	6	EMI INDR FERRITE BEAD SURFACE Z145.000 OHM 100.000	0.6	BRAEMAC - USD ACCOUNT	TDK Corp	Chilisin Electronics Corp	GCI Technologies Inc							GC INTERNATIONAL INCORPORATED(SMDB)	GARRY ELECTRONICS (SMDB)	BOCA NORTH ELECTRONICS INCORPORATED (SMDB)	SOLECTRON CORPORATION (SMDB)					
A0620871	1	DC POWER JACK STR PCB	0.3231	FUTURE ELECTRONICS INC	Technic Industrial Co	Framatome Connectors																
A0316553	2	CONN TELEDAPT TEL ARRAY 0.040 PITCH AUPD FEMALE ST	0.2093	ARROW USD ACCOUNT	AMP Inc A Tyco Electronics Company	Framatome Connectors	Molex Inc							Kent Electronics								
A0316552	1	CONN TELEDAPT TEL ARRAY 0.040 PITCH AUPD FEMALE ST	0.1545	ARROW USD ACCOUNT	AMP Inc A Tyco Electronics Company	Framatome Connectors	Molex Inc							Kent Electronics	SCI SYSTEMS INC (SMDB)							
P0906361	1	PCB FOR NTEX0011	11.77	DAE DUCK ELECTRONICS CO LTD																		
A0793968	1	XFMR POWER FLYBACK SURFACE 6 OUTPUTS	1.4677	PULSE ELECTRONICS (S'PORE) P/L	Pulse Engineering Inc																	
A0345678	1	DIODE HIGH SPEED SWITCHING 200V 0.2A SMD	0.0278	ARROW USD ACCOUNT	Philips Components	Infineon Technologies Corp	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor	Zetex Inc						FUTURE ELECTRONICS (SMDB)	ARROW ELECTRONICS (SMDB)	CELESTICA INCORPORATED (SMDB)	SEMICONDUCTO R COMPONENTS IND LLC (SMDB)				
A0336557	1	DIODE DUAL COM.CATH. 70V 0.25A SMD	0.0207	PHILIPS COMPONENTS USD	Philips Components	Zetex Inc	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor	Infineon Technologies Corp								ARROW ELECTRONICS (SMDB)	SEMICONDUCTO R COMPONENTS IND LLC (SMDB)				
A0379753	2	SEMICONDUCTOR, LED, RED, SUBMINIATURE T3/4, STRAIG	0.379	ARROW USD ACCOUNT				Fairchild Semiconductor						ARROW ELECTRONICS (SMDB)								
A0602462	4	DIODE, LED, RED, ALGAAS, SMD	0.3647	REC ELECTRONICS (USD ACCOUNT)				Fairchild Semiconductor	Infineon Technologies Corp													
A0600914	4	DIODE RECTIFIER 400V 1A SMD	0.2354	AVNET - USD ACCOUNT	Philips Components	Rectron USA	ON Semiconductor Semiconductor Components Ind L	Telefunken Corp	Fairchild Semiconductor	Rohm Electronics	General Semiconductor Inc	Nihon Inter Electronics Corp		GENERAL INSTRUMENTS (SMDB)	ARROW ELECTRONICS (SMDB)	SEMICONDUCT OR COMPONENTS IND LLC (SMDB)	DEPENDABLE COMPONENT SUPPLY CORP (SMDB)	SND ELECTRONICS (SMDB)	SEMISPECIALISTS OF AMERICA INCORPORATED (SMDB)	PREMIER FARNELL PLC (SMDB)		
A0385642	1	DIODE, RECTIFIER, SCHOTTKY, 100V/1A, SMD	0.1413	AVNET - USD ACCOUNT		STMicroelectro nics Incorporated	ON Semiconductor Semiconductor Components Ind L	International Rectifier	Motorola Inc						ARROW ELECTRONICS (SMDB)	SEMICONDUCT OR COMPONENTS IND LLC (SMDB)	PREMIER FARNELL PLC (SMDB)	FREEWAY ELECTRONICS (SMDB)				
A0600797	1	DIODE SCHOTTKY 40V 3A SMD	0.1825	REC ELECTRONICS (USD ACCOUNT)			ON Semiconductor Semiconductor Components Ind L	International Rectifier			General Semiconductor Inc	Diodes Inc			ARROW ELECTRONICS (SMDB)	SEMICONDUCT OR COMPONENTS IND LLC (SMDB)	DEPENDABLE COMPONENT SUPPLY CORP (SMDB)	GC INTERNATIONAL INCORPORATED(SMDB)	SCI SYSTEMS INC (SMDB)	CELESTICA INCORPORATED (SMDB)		
A0351182	6	DIO DUAL 100V 0.2A SURFACE	0.1302	AVNET - USD ACCOUNT	Philips Components	Zetex Inc	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor						PIONEER STANDARD ELECTRONICS INCORPORATED (SMDB)	ARROW ELECTRONICS (SMDB)	SEMICONDUCT OR COMPONENTS IND LLC (SMDB)	PREMIER FARNELL PLC (SMDB)					

Appendix XV.

Ecodesign Proposals for i2004

Appendix XV Ecodesign Proposals for i2004 Next Generation Design (Hamra and Collins, 1999)

1. Speaker Enclosure

•**Current Design:** The speaker enclosure consists of 2 molded pieces of ABS plastic, assembled with an elastomeric gasket between them, to assure a tight seal. The two pieces are fastened together with 6 Phillips screws. The ABS pieces are 2.5mm in thickness and the speaker enclosure weighs 71.4 grams.

•**Proposal 1:** Ultrasonically weld the 2 molded ABS pieces together, with the loudspeaker mounted inside, to form a sealed but separate speaker enclosure.

•**Environmental Advantage**: This change would reduce the component count (eliminating the gasket and the 6 screws) and the time for final assembly and disassembly. At recycling the assembly could be sliced or crushed to remove the speaker assembly. A preliminary trial of this construction was attempted but additional analysis is required.

•**Proposal 2**: Mold the 2 halves of the speaker enclosure as integral parts of the telephone set's front and rear case.

•**Environmental Advantage**: In this proposal, the gasket is still required but the two separate pieces of ABS plastic are eliminated. Some of the original 6 screws may still be required, to apply enough pressure to seal the gasket, but these screws would appear in the rear case of the set, not internally. In the integrated set, the total weight of ABS plastic should be reduced. Final assembly time should also be reduced.

—Notes: The round audio port in the rear of the speaker enclosure requires a tool which is withdrawn from the mold before it is released. The current design with the 2 piece enclosure also requires this type of tool. The 2 proposals above should be evaluated by the mechanical design team for selection, based on total costs.

2. Speaker Grill Cover

•**Current Design:** The speaker grill is a snap-fit design consisting of an array of perforations made in a Delrin (an acetyl resin from Dupont) panel. The grill cover is 1.45mm in thickness. Its design is intended to enhance the image of the i2004 Internet Telephone set. No attempt was made to use ABS plastic because SPM, (the plastic molders in Calgary contracted for E2 work), considered the size of the perforations too small for the flow characteristics of ABS. The cost of the double cavity tool for the Delrin grill alone was $110k, whereas the tools for the front and rear ABS case for the E2 set was only $60k. There is clearly an opportunity to reduce the cost of the set here.

•**Proposal 1:** Run tests to see if molding a similar snap-fit grill design in ABS is possible.

•**Environmental Advantage**: An ABS grill would reduce the number of types of materials used in the set, the number of processing steps and the cost and energy to manufacture the set. Delrin costs almost 3 times that of ABS ($2.18/lb U.S. whereas ABS costs $0.74/lb). Nortel's recycling plants only handle ABS at this point in time. Introducing a new material such as Delrin could have a negative impact.

•**Proposal 2**: Modify the set design, to fully integrate the speaker grill into the molded front case.

•Environmental Advantage This change would reduce the cost of the product by eliminating the expensive mold for a separate Delrin grill. It would also reduce the number of parts for assembly and also reduce the number of materials for recycling.

—Notes: To successfully adopt either proposal above, the set designers should consider modifying the specified grill hole diameter and hole pitch, to allow the use of ABS plastic. The potential cost and environmental advantages could be realized with little effect on the perception of the set's image.

3. Printed Circuit Board (PCB)

•Current Design: The E2 set has a single, fine pitch, 6 layer FR-4 PCB, with a gold finish over copper tracks. The board is 1.5mm (60 thou) in thickness and measures 14 cm x 18.8 cm. It is assembled with single-sided through hole and surface mount components. The secondary side of the PCB is bare of components, which provides a smooth flat surface for 38 keypads. *This strategy requires that the PCB must be as extensive as the length and breadth of user keys, across the set.* The display connections are heat sealed onto the board. Two mylar circuits are connected to the PCB with a pressure connect, to access the hookswitch and speaker phone keys. Silver inks were used on the mylars, for high conductivity.

•Proposal 1: Reduce the FR-4 PCB area by up to one-half, by changing the design to a double sided PCB for component mounting and a mylar circuit, for all key contacts. This effectively decouples FR-4 PCB area from the distribution of user keys. The large components in the power circuit (this set is powered from an AC converter) may restrict the available board area reduction.

•Environmental Advantage This proposal could result in a reduction in the material and the cost to manufacture and to recycle this product. A trade-off analysis is required to determine the best strategy for reducing the FR-4 board, while growing the mylar keyboard.

•Proposal 2: Further reduce the set's FR-4 PCB area and electronic component count by highly integrating active components on custom silicon ASICs. The IC selection and integration for the next generation internet telephone set is already being investigated by Paul Smeulders of AT22. A cost analysis of this option should be guided by his recommendations.

•Environmental Advantage Same as Proposal 1 above. A cost analysis is required to determine the extent of this opportunity.

Notes: Proposals 1 and 2 above are complimentary and could be initiated one after the other or at the same time.

Liquid Crystal Display (LCD)

Current Design: The E2 set uses a monochrome STN display cell, attached to the PCB with two heat seal connectors. An ABS plastic mechanical support, 2.0 mm in thickness, is located behind the display. The drivers and controller for the LCD (PQFP and BGA packages) are resident on the PCB.

•Proposal: Migrating the display driver/controller circuits into Chip-on-glass (COG) or Tape automated bonding (TAB) packaging could reduce PCB size--there will be fewer ICs on the PCB and the resulting interface with the PCB will be much less real estate intensive than the heat seal landing sites. This "thinner" type of interface (i.e. 30 to 50 signals instead of 224) should result in lower material and process costs than with heat seal. Interfacing to a display "module" instead of to just a cell is also the means to evolve to a display with higher resolution than the current one (see "Notes" below). A cost analysis is required to make a recommendation.

•**Environmental Advantage:** The packaging alternatives could provide a reduction in the number of processing steps, energy, amount of material used and potentially the cost to manufacture.

— Notes: The next generation internet telephone set will likely offer a full graphics display. Upscale sets could offer displays as advanced as colour VGA.

Appendix XVI.

SNSE Bill of Materials

Appendix XVI BoM SNSE

Eng Code		CPC	Description			Shelf Position		Price (US$)	Supplier 1	Supplier 2	Supplier 3	Supplier 4	Supplier 5	Supplier 6	Supplier 7	Supplier 8	Supplier 9	Supplier 10	Supplier 11	Supplier 12
NTZZ34AH	1	B0246093	DMS SUPERNODE SE	SCC 00			SCC													
Product	Qty	CPC	Title	CIL	REL															
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NTZZ34AH		B0246093	DMS SUPERNODE SE	1	2															
-NPS90558-06L07	8	A0379486	LENGTH = 2.2 METERS, MULTIMODE, 62.5/125 UM, ST-ST																	
-NT9X0160	2	B0223469	CA ASSY	9	12															
--CRP14CP2426G50Q2	25	A0381731	CONN CONTACT D SUB 24-26 AU CRIMP																	
--CRP14CS2426G50Q2	25	A0380887	CONN CONTACT D SUB 24-28 AU CRIMP																	
--CRP14H25M120L7	1	A0361583	CONN D SUB D ARRAY 0.109 PITCH NONE MALE NA																	
--CRP14H25RTIN	1	A0361582	CONN D SUB D ARRAY 0.109 PITCH NONE FEMALE NA																	
--P0734507	4	P0734507	4-40 JACKSCREW (MED INT)	2	0															
--R0102866	0.85	R0102866	SWBD CBL 26AWG 1X26 TIN CU 16 PAIR NO SHLD PVC																	
-NT9X0167	2	B0225639	CABLE ASSY	6	4															
--CRP14CP2024G50	2	A0369920	CONN CONTACT D SUB 20-24 AU CRIMP																	
--CRP14CP2426G50Q2	72	A0381731	CONN CONTACT D SUB 24-26 AU CRIMP																	
--CRP14H37MTDQ2	2	A0380876	CONN D SUB D ARRAY 0.109 PITCH NONE MALE NA																	
--P0734507	4	P0734507	4-40 JACKSCREW (MED INT)	2	0															
--R0061319	0.71	R0061319	SWBD CBL 26AWG 1X26 TIN CU 20 PAIR NO SHLD PVC																	
-NT9X0196	2	B0230165	RS232C & CURRENT LOOP CABLE ASSEMBLY	4	4															
--CRP14CP2024G50	4	A0369920	CONN CONTACT D SUB 20-24 AU CRIMP		7															
--CRP14CP2426G50Q2	13	A0381731	CONN CONTACT D SUB 24-26 AU CRIMP		7															
--CRP14CS2426G50Q2	21	A0380887	CONN CONTACT D SUB 24-28 AU CRIMP		7															
--CRP14H09RTQ2	1	A0368362	CONN D SUB D ARRAY 0.108 PITCH NONE FEMALE NA		7															
--CRP14H25M120L7	1	A0361583	CONN D SUB D ARRAY 0.109 PITCH NONE MALE NA		7															
--CRP14H25RTIN	1	A0361582	CONN D SUB D ARRAY 0.109 PITCH NONE FEMALE NA																	
--P0734507	4	P0734507	4-40 JACKSCREW (MED INT)	2	0															
--P0735085	2	P0735085	JACKSCREW, FILLISTER HEAD, SLOT. THREAD: 0.112-40,	1	0															
--R0102866	0.76	R0102866	SWBD CBL 26AWG 1X26 TIN CU 16 PAIR NO SHLD PVC		7															
--R0113077	0.06	R0113077	HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE 0.500 0.025 UL		7															
--R0113085	0.76	R0113085	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246		7															
-NT9X01MB	1	B0233793	WSSPR CORE CABINET	43	9															
--NPS50004-06L03	1	A0377837	WHITE POLYESTER AIR FILTER, 80% AVG DUST ARRESTANC																	
--NT0X2479	5	B0226991	HORIZONTAL TROUGH ASSEMBLY	3	2															
---P0689347	1	P0689347	HORIZONTAL TROUGH BASE	1	0															
---P0689349	3	P0689349	HORIZONTAL TROUGH FINGERS	1	0															
---P0708963	2	P0708963	CABLE ORGANIZER SPACER	1	0															
---P0739123	2	P0739123	GROMMET	2	0															
--NT0X9503	1	B0206739	CABLE BRAID ASSEMBLY	5	4															
---NPS50065-01L7	2	A0288149	CONN TERMINAL LUG RING PLAIN 6																	
---R0109137	0.901	R0109137	BARE WIRE ROUND BRAID COPPER TIN COATED 0.781" ID,																	
---R0113077	0.901	R0113077	HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE 0.500 0.025 UL																	
--NT0X9538	18	B0209630	3IN. CABLE BRAID ASSEMBLY	5	3															
---NPS50065-01L7	2	A0288149	CONN TERMINAL LUG RING PLAIN 6																	
---R0109137	0.102	R0109137	BARE WIRE ROUND BRAID COPPER TIN COATED 0.781" ID,																	
---R0113077	0.102	R0113077	HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE 0.500 0.025 UL																	
--NT9X0141	2	B0224453	CABLE ASSEMBLY (FSP TO SHELF ALARM)	9	4															
---CRP14CP2426G50Q2	16	A0381731	CONN CONTACT D SUB 24-26 AU CRIMP																	
---CRP14H09MTDQ2	2	A0368361	CONN D SUB D ARRAY 0.108 PITCH NONE MALE NA																	
---P0735085	4	P0735085	JACKSCREW, FILLISTER HEAD, SLOT. THREAD: 0.112-40,	1	0															
---R0113085	1.1	R0113085	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246																	
--NT9X0142	2	B0224454	CABLE ASSEMBLY (FSP TO SHELF ALARM)	9	4															
---CRP14CP2426G50Q2	16	A0381731	CONN CONTACT D SUB 24-26 AU CRIMP																	
---CRP14H09MTDQ2	2	A0368361	CONN D SUB D ARRAY 0.108 PITCH NONE MALE NA																	
---P0735085	4	P0735085	JACKSCREW, FILLISTER HEAD, SLOT. THREAD: 0.112-40,	1	0															
---R0113085	1.5	R0113085	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246																	
--NT9X0143	2	B0224455	CABLE ASSEMBLY (FSP TO SHELF ALARM)	9	4															
---CRP14CP2426G50Q2	16	A0381731	CONN CONTACT D SUB 24-26 AU CRIMP																	
---CRP14H09MTDQ2	2	A0368361	CONN D SUB D ARRAY 0.108 PITCH NONE MALE NA																	
---P0735085	4	P0735085	JACKSCREW, FILLISTER HEAD, SLOT. THREAD: 0.112-40,	1	0															
---R0113085	2	R0113085	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246																	
--NT9X0144	2	B0224456	CABLE ASSEMBLY (FSP TO SHELF ALARM)	10	4															
---CRP14CP2426G50Q2	16	A0381731	CONN CONTACT D SUB 24-26 AU CRIMP																	
---CRP14H09MTDQ2	2	A0368361	CONN D SUB D ARRAY 0.108 PITCH NONE MALE NA																	
---P0735085	4	P0735085	JACKSCREW, FILLISTER HEAD, SLOT. THREAD: 0.112-40,	1	0															
---R0113085	2.1	R0113085	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246																	
--NT9X0470	1	B0233884	COMBINED MESSAGE SWITCH SHELF ASSEMBLY	11	3															
---NPS50394-03L2	2	A0326749	BUS BAR																	
---NT9X0406	1	B0223461	CONN BACKPLANE CABLE ASSY	7	6															
----CRC06M002	32	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU																	
----CRC07HC20N00	2	A0322604	CONN STR HOUSING 2X10 ARRAY 0.100 PITCH NONE FEMAL																	
----R0105561	0.25	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA																	
----R0107948	4.877	R0107948	HOOK-UP WIRE, SINGLE, UL 1429, CSA AWMXLPVC, 24AWG																	
---NT9X0408	1	B0223787	CABLE ASSY	7	6															
----CRC06M002	32	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU																	
----CRC07HC20N00	2	A0322604	CONN STR HOUSING 2X10 ARRAY 0.100 PITCH NONE FEMAL																	
----R0105561	0.25	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA																	
----R0107948	4.064	R0107948	HOOK-UP WIRE, SINGLE, UL 1429, CSA AWMXLPVC, 24AWG																	
---NT9X0471	1	B0233885	COMBINED MESSAGE SWITCH BACKPANEL ASSEMBLY	1	1															
----CFC22C16A06	2	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR																	
----CTP21H360C	26	A0344714	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA																	
----CTP21H360CNR1	26	A0325203	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA																	
----NPS25230L18D	8216	A0354273	PCB PIN COMPLIANT																	
----NPS25230L21D	1144	A0354276	PCB PIN COMPLIANT																	
----NT9X0472	1	P0729690	NT9X0472 COMBINED MESSAGE SWITCH BACKPLANE PCB	2	1															
----P0183093	26	P0183093	LOCK WASHER																	
----P0251628	4	P0251628	TAPPING SCREW TAPPING SCR S F PAN HEAD (SLTD) 0.11																	
----P0639584	11	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010																	
----P0669306	52	P0669306	SOCKET HEAD CAP SCREW																	
----P0669307	26	P0669307	4X90 CONNECTOR GUIDE PIN																	
----P0669314	26	P0669314	4X90 CONNECTOR SOCKET GUIDE PIN																	
----P0669316	52	P0669316	POLARIZING KEY THREADED	1	0															
----P0669317	52	P0669317	4X90 CONNECTOR POLAR KEY-UNTHREAD	2	0															
---NT9X0490	1	B0238936	E-CORE COMMON SHELF HAREWARE KIT	1	1															
----P0668728	1	P0668728	LOWER CARD GUIDE	3	0															
----P0668734	1	P0668734	UPPER PERSONALITY CARD GUIDE	4	0															
----P0668735	1	P0668735	LOWER PERSONALITY CARD GUIDE	3	0															
----P0668736	1	P0668736	FRONT UPPER EXTRUSION	1	0															
----P0668737	1	P0668737	FRONT LOWER EXTRUSION	1	0															
----P0668738	1	P0668738	REAR UPPER EXTRUSION	1	0															
----P0668739	1	P0668739	REAR LOWER EXTRUSION	1	0															
----P0668740	1	P0668740	REAR UPPER CARD GUIDE SCREEN	1	0															
----P0668741	1	P0668741	REAR LOWER CARD GUIDE SCREEN	1	0															
----P0669233	2	P0669233	SHELF REINFORCING ROD	1	0															
----P0706864	2	P0706864	BACKPANEL BRACKET	4	0															
----P0710461	1	P0710461	UPPER CARD GUIDE	6	0															
----P0729861	2	P0729861	SHELF MOUNTING BRACKET	4	0															
----P0729862	1	P0729862	LEFT SIDE PANEL	3	0															
----P0729863	1	P0729863	RIGHT SIDE PANEL	3	0															
----P0729871	2	P0729871	SHELF MOUNTING BRACKET	1	0															
----P0744405	2	P0744405	END PLATE	1	0															
----P0744408	2	P0744408	COVER PLATE	1	0															
----P0744410	1	P0744410	LEFT SIDE CENTER SUPPORT	1	0															
----P0744411	1	P0744411	RIGHT SIDE CENTER SUPPORT	3	0															
---NT9X2824	2	B0238937	POWER CONVERTER BACKPANEL ASSEMBLY	1	1															
----CBR30B020S	2	A0299030	CONN TOP ENTRY 2X10 ARRAY 0.100 PITCH AU FEMALE ST																	
----CFC22C16A06	1	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR																	
----CTP20B48VNS6	2	A0319277	CONN STR RECEPT, P. DIN 3X16 ARRAY 0.200 PITCH AU																	

---CTP20B64VNS9		2	A0326973	CONN STR RECEPT, P, DIN 4X16 ARRAY 0.200 PITCH AU		
---NT9X2827		1	P0742781	POWER CONVERTER BACKPLANE PCB (NT9X2827)	1	1
----P0142036		3	P0142036	SCREW,PAN HEAD(MACH),SLOTTED, 0.138-32 X 0.625		
----P0180686		8	P0180686	MACHINE SCREW MACH SCR S PAN HEAD SLOTTED 0.086-56		
----P0182942		8	P0182942	LOCK WASHER		
----P0183093		8	P0183093	LOCK WASHER		
----P0298849		8	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
----P0594346		3	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
----P0639584		4	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010		
----P0675200		2	P0675200	POST KEY		
----P0675201		1	P0675201	POST TURRET		
----P0675202		2	P0675202	KEYING POST		
----P0675203		1	P0675203	CONNECTOR SHROUD		
----P0675204		4	P0675204	CONNECTOR POST		
----P099D274		2	P099D274	TAPPING SCREW TAPPING SCR S B PAN HEA		
--NT9X6107		2	B0238940	INTERFACE PANEL ASSEMBLY	2	2
---CRP04W09V651		1	A0608797	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP		
---CRP14M002		1	A0279333	D SUB FEMALE SCREW LOCK		
---FTB1X3A		1	A0805068	FILTERED TERMINAL BLOCK		
---NT0X2706		1	B0238938	INTERFACE PANEL MECH. ASSEMBLY	1	1
----P0639815		2	P0639815	STANDOFF SELF-CLINCH, INT THD, (PENN ENG. SOS-440-		
----P0661462		2	P0661462	STANDOFF SELF-CLINCH, BLIND, 0.112-40, SS		
----P0744409		1	P0744409	INTERFACE PLATE	2	0
---NT1X6111		1	B0239829	POWER INTERFACE CP	1	1
----CB18X7RA331K		9	A0274436	CAP CER AX 330PF 100V 10%		
----CRP04L09PN		1	A0291697	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP		
----CTP27P020VN		1	A0604967	CONN STR HEADER 2X10 ARRAY 0.100 PITCH AUPD M-M AD		
----NT9X6108		1	P0742783	POWER INTERFACE PCB (NT9X6108)	1	2
-----P099D465		2	P099D465	SCREW, TYPE B PAN HD SLT, 0.112-24X0.188, STEEL, 2		
-----SPC13C9W3LD		2	A0604955	SW TOGGLE 2PDT (ON)-ON-(ON) W WRAP TERM		
---P0180927		2	P0180927	PHM SCREW 0.112-40 X 0.500 X 0.219		
---P0242824		2	P0242824	PHM SCR .112X40X1.375		
---P0249752		2	P0249752	LOCK WASHER		
---P0594316		2	P0594316	KEPS, PREASSEMBLED, HEX NUT & EXT LOCKWASHER .112		
---P0594346		2	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
---QD-HP4655		2	A0270192	DIODE LED RED		
---R0114610		2	R0114610	EMI/RFI BERYLLIUM COPPER SLOTTED SHIELDING,SELF-AD		
---SPC13C9W3LD		2	A0604955	SW TOGGLE 2PDT (ON)-ON-(ON) W WRAP TERM		
--P0138380		4	P0138380	MACHINE SCREW MACHINE S		
--P0242132		36	P0242132	WASHER, SPRING HELICAL .168 X 0.296 X 0.040		
--P0284145		32	P0284145	WASHER		
--P0559409		130	P0559409	THREADED FORMING SCREW, HEX WSHR HD TYPE TT, 0.138		
--P0594346		48	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
--P0627369		6	P0627369	HEX NUT & WASHER ASSY (KEPS)		
--P0631766		10	P0631766	RIVET, MATL CODE= S 289A FINISH, DIA= 0.125 0.425		
--P0633700		14	P0633700	CABLE TIE, LOCKING, MAX BUNDLE DIAMETER: 0.87", LE		
--P0633746		4	P0633746	CABLE TIE MOUNTING BASE, SCREW MOUNT FOUR WAY, MAT		
--P0668725		2	P0668725	CARD GUIDE EMI SCREEN	2	0
--P0676101		48	P0676101	LOCK WASHER, EXT TOOTH, PHOSPHOR BRONZE FIN: 562A,		
--P0678310		2	P0678310	SEE P0633725 AS POSSIBLE SUBSTITUTE		
--P0706928		4	P0706928	SHELF GASKET	2	0
--P0739089		1	P0739089	SHELF STRIP MS (FRONT)	3	0
--P097G010		96	P097G010	TAPTITE TAP SCREW		
--P097Y561		16	P097Y561	TOPTITE TAPPING SCREW		
--P099Q897		48	P099Q897	6-32 HEX NUT		
--R0109727		3.178	R0109727	EMI GASKET MATL,RUBBER,DIA4.78MM(0.188")MONEL OVER		
-NT9X0522		2	B0229931	FSP - BULKHEAD CABLE ASSY	6	4
--CRP04G25T50G		1	A0361662	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE IDT 2426		
--CRP14M061		1	A0323869	CONN HOOD D SUB D-25 ARRAY		
--P0537242		2	P0537242	TAPPING SCREW TAPPING S		
--P0559609		1	P0559609	BODY ASSY		
--P0633700		1	P0633700	CABLE TIE, LOCKING, MAX BUNDLE DIAMETER: 0.87", LE		
--R0101768		0.609	R0101768	26AWG 10PR 1X26 TCU, PVC INS, PVC JKT, UL2464, CMR		
-NT9X0610		1	B0231170	COMPACT CM SHELF ASSY (C-CM)	18	4
--NPS50394-03L4		2	A0361374	BUSBAR		
--NT9X0406		4	B0223461	CONN BACKPLANE CABLE ASSY	7	6
---CRC06M002		32	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU		
---CRC07HC20N00		2	A0322604	CONN STR HOUSING 2X10 ARRAY 0.100 PITCH NONE FEMAL		
---R0105561		0.25	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA		
---R0107948		4.877	R0107948	HOOK-UP WIRE, SINGLE, UL 1429, CSA AWMXLPVC, 24AWG		
--NT9X0410		6	B0223798	CA ASSY	11	4
---NPS50055-01L179		1	A0382114	CONN TERMINAL LUG RING PLAIN 12-10		
---NPS50055-01L53		1	A0292996	CONN TERMINAL LUG RING PLAIN 12-10		
---R0103145		0.349	R0103145	HOOK-UP WIRE, SINGLE, UL 1015, CSA TEW-105, 10AWG		
--NT9X0411		1	B0230269	E-CORE COMMON SHELF HARDWARE KIT	5	2
---P0668727		2	P0668727	END PLATE	3	0
---P0668728		1	P0668728	LOWER CARD GUIDE	3	0
---P0668734		1	P0668734	UPPER PERSONALITY CARD GUIDE	3	0
---P0668735		1	P0668735	LOWER PERSONALITY CARD GUIDE	3	0
---P0668736		1	P0668736	FRONT UPPER EXTRUSION	1	0
---P0668737		1	P0668737	FRONT LOWER EXTRUSION	1	0
---P0668738		1	P0668738	REAR UPPER EXTRUSION	1	0
---P0668739		1	P0668739	REAR LOWER EXTRUSION	1	0
---P0669232		2	P0669232	COVER PLATE	1	0
---P0669233		2	P0669233	SHELF REINFORCING ROD	1	0
---P0706861		1	P0706861	REAR UPPER CARD GUIDE SCREEN	2	0
---P0706862		1	P0706862	REAR LOWER CARD GUIDE SCREEN	1	0
---P0706864		2	P0706864	BACKPANEL BRACKET	4	0
---P0710461		1	P0710461	UPPER CARD GUIDE	6	0
---P0729861		2	P0729861	SHELF MOUNTING BRACKET	2	0
---P0729862		1	P0729862	LEFT SIDE PANEL	2	0
---P0729863		1	P0729863	RIGHT SIDE PANEL	2	0
---P0729868		1	P0729868	RIGHT CENTER SUPPORT	2	0
---P0729869		1	P0729869	LEFT CENTER SUPPORT	2	0
---P0729871		2	P0729871	SHELF MOUNTING BRACKET	1	0
--NT9X0611		1	B0231171	COMPACT CM BACKPANEL ASSY	3	2
---CFC22C16A06		4	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR		
---CTP21H360C		26	A0344714	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA		
---CTP21H360CNR1		26	A0325203	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA		
---NPS25230L1D		5668	A0344712	PCB PIN COMPLIANT (REPLACED BY A0354273 FOR .100 P		
---NPS25230L2D		792	A0344713	PCB PIN COMPLIANT		
---NT9X0612		1	P0710119	COMPACT CM BACKPANEL PCB	3	2
---P0183093		26	P0183093	LOCK WASHER		
---P0251628		8	P0251628	TAPPING SCREW TAPPING SCR S F PAN HEAD (SLTD) 0.11		
---P0639584		11	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010		
---P0669306		52	P0669306	SOCKET HEAD CAP SCREW		
---P0669307		26	P0669307	4X90 CONNECTOR GUIDE PIN		
---P0669314		26	P0669314	4X90 CONNECTOR SOCKET GUIDE PIN		
---P0669316		52	P0669316	POLARIZING KEY THREADED	1	0
---P0669317		52	P0669317	4X90 CONNECTOR POLAR KEY-UNTHREAD	2	0
--NT9X0613		4	B0231172	CM POWER BACKPLANE CABLE ASSEMBLY	3	3
---NPS50055-01L179		2	A0382114	CONN TERMINAL LUG RING PLAIN 12-10		
---R0103145		0.762	R0103145	HOOK-UP WIRE, SINGLE, UL 1015, CSA TEW-105, 10AWG		
--NT9X2811		2	B0226769	STP POWER BACKPANEL	2	2
--NT9X2812		1	B0226770	STP POWER BACKPANEL ASSY	6	2
---CFC22C16A06		2	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR		
---CTP20B64VNS9		4	A0326973	CONN STR RECEPT, P, DIN 4X16 ARRAY 0.200 PITCH AU		
---NT9X2813		1	P0702106	AP/FP POWER BACKPANEL PCB	2	2
---P0142036		4	P0142036	SCREW,PAN HEAD(MACH),SLOTTED, 0.138-32 X 0.625		
---P0180686		8	P0180686	MACHINE SCREW MACH SCR S PAN HEAD SLOTTED 0.086-56		
---P0182942		8	P0182942	LOCK WASHER		

----P0183093	8	P0183093	LOCK WASHER		
----P0298849	8	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
----P0594346	4	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
----P0675200	2	P0675200	POST KEY		
----P0675201	2	P0675201	POST TURRET		
----P0675202	2	P0675202	KEYING POST		
----P0675203	1	P0675203	CONNECTOR SHROUD		
----P0675204	4	P0675204	CONNECTOR POST		
----P099D274	4	P099D274	TAPPING SCREW TAPPING SCR S B PAN HEA		
---NT9X2814	1	B0230064	CABLE ASSEMBLY POWER INTERFACE	3	1
----CRC06M002	18	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU		
----CRC07HC24N00	1	A0328583	CONN STR HOUSING 2X12 ARRAY 0.100 PITCH NONE FEMAL		
----NT9X2815	1	B0230065	POWER CABLE ASSEMBLY	1	1
---P0639584	4	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010		
---P0676101	5	P0676101	LOCK WASHER, EXT TOOTH, PHOSPHOR BRONZE FIN: 562A,		
---P0691818	5	P0691818	BELLEVILLE WASHER, STAINLE		
---P0691819	5	P0691819	8-32 TWIN HEX WHIZLOCK NUT		
---P099M457	5	P099M457	MACHINE SCREW		
--NT9X6105	1	B0229957	SDS POWER INTERFACE COMPONENT ASSEMBLY CPNTA	1	1
---A0326932	3	A0326932	50A FEEDTHRU FILTER, 0.22UF, MAX TORQUE =25IN-LBS,		
---CRP04L09PN	1	A0291697	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP		
---CRP14M002	1	A0279333	D SUB FEMALE SCREW LOCK		
---NT0X2562	1	B0230345	INTERFACE MECHANICAL ASSY	1	1
----P0668742	1	P0668742	SHELF INTERFACE PANEL LABEL		
----P0676108	2	P0676108	STANDOFF SELF-CLINCH, SS, FIN: 662A, (PENN ENG. SO		
---NT9X6101	1	B0223800	POWER INTERFACE COMPONENT ASSEMBLY	5	2
----CB18X7RA331K	9	A0274436	CAP CER AX 330PF 100V 10%		
----CFC02Q20A01	1	A0293227	CONN STR HEADER 2X10 ARRAY 0.100 PITCH AUPD MALE S		
----NT9X6102	1	P0675065	PCB FOR NT9X6101	1	1
-----P099D465	2	P099D465	SCREW, TYPE B PAN HD SLT, 0.112-24X0.188, STEEL, 2		
---P0180927	2	P0180927	PHM SCREW 0.112-40 X 0.500 X 0.219		
---P0249752	2	P0249752	LOCK WASHER		
---P0594316	2	P0594316	KEPS, PREASSEMBLED, HEX NUT & EXT LOCKWASHER .112		
---P0678343	6	P0678343	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
---QD-HP4655	2	A0270192	DIODE LED RED		
---R0112824	1	R0112824	RFI/EMI BERYLLIUM COPPER SHIELDING GASKET SERIES 5		
---SPC13C9C3LD	2	A0328551	SW TOGGLE 2PDT (ON)-ON-(ON) STR PC TERM		
--NT9X6106	1	B0229959	AP POWER INTERFACE COMPONENT ASSEMBLY CPNTA	1	1
---A0326932	3	A0326932	50A FEEDTHRU FILTER, 0.22UF, MAX TORQUE =25IN-LBS,		
---CRP04L09PN	1	A0291697	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP		
---CRP14M002	1	A0279333	D SUB FEMALE SCREW LOCK		
---NT0X2561	1	B0230344	INTERFACE MECHANICAL ASSY	1	1
----P0668742	1	P0668742	SHELF INTERFACE PANEL LABEL		
----P0676108	2	P0676108	STANDOFF SELF-CLINCH, SS, FIN: 662A, (PENN ENG. SO		
---NT9X6101	1	B0223800	POWER INTERFACE COMPONENT ASSEMBLY	5	2
----CB18X7RA331K	9	A0274436	CAP CER AX 330PF 100V 10%		
----CFC02Q20A01	1	A0293227	CONN STR HEADER 2X10 ARRAY 0.100 PITCH AUPD MALE S		
----NT9X6102	1	P0675065	PCB FOR NT9X6101	1	1
-----P099D465	2	P099D465	SCREW, TYPE B PAN HD SLT, 0.112-24X0.188, STEEL, 2		
---P0180927	2	P0180927	PHM SCREW 0.112-40 X 0.500 X 0.219		
---P0249752	2	P0249752	LOCK WASHER		
---P0594316	2	P0594316	KEPS, PREASSEMBLED, HEX NUT & EXT LOCKWASHER .112		
---P0678343	6	P0678343	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
---QD-HP4655	2	A0270192	DIODE LED RED		
---R0112824	1	R0112824	RFI/EMI BERYLLIUM COPPER SHIELDING GASKET SERIES 5		
---SPC13C9C3LD	2	A0328551	SW TOGGLE 2PDT (ON)-ON-(ON) STR PC TERM		
--P0138380	4	P0138380	MACHINE SCREW MACHINE S		
--P0210810	2	P0210810	MACHINE SCREW MACH SCR S PAN HEAD SLO		
--P0242132	36	P0242132	WASHER, SPRING HELICAL .168 X 0.296 X 0.040		
--P0284145	32	P0284145	WASHER		
--P0559409	178	P0559409	THREADED FORMING SCREW, HEX WSHR HD TYPE TT, 0.138		
--P0594346	48	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
--P0631766	10	P0631766	RIVET, MATL CODE= S 289A FINISH, DIA= 0.125 0.425		
--P0633700	10	P0633700	CABLE TIE, LOCKING. MAX BUNDLE DIAMETER: 0.87", LE		
--P0668725	2	P0668725	CARD GUIDE EMI SCREEN	2	0
--P0676101	62	P0676101	LOCK WASHER, EXT TOOTH, PHOSPHOR BRONZE FIN: 562A,		
--P0678310	2	P0678310	SEE P0633725 AS POSSIBLE SUBSTITUTE		
--P0678343	12	P0678343	BELLEVILLE WASHER, MAT: SS, FIN: 662A		
--P0706928	4	P0706928	SHELF GASKET	2	0
--P0739104	1	P0739104	SHELF STRIP CM/SLM (FRONT)	3	0
--P097G010	60	P097G010	TAPTITE TAP SCREW		
--P097Y561	16	P097Y561	TOPTITE TAPPING SCREW		
--P099Q897	48	P099Q897	6-32 HEX NUT		
--R0109727	125	R0109727	EMI GASKET MATL,RUBBER,DIA4.78MM(0.188")MONEL OVER		
-NT9X9505	2	P0727913	LOGIC GROUND BAR	4	2
-NT9X96BA	1	B0238864	C42 CABINET MECHANICAL ASSEMBLY	4	1
--NT9X9580	1	B0238763	C42 CABINET MECHANICAL ASSEMBLY	3	2
---NT9X0105	1	B0243691	BLACK FRAME FAIL LIGHT KIT ASSEMBLY	1	1
----NPS50065-13L36	2	A0297938	CONN TERMINAL LUG DISCONNECT FI 22-18		
----P0675727	1	P0675727	TERMINAL 1		
----P0675728	1	P0675728	TERMINAL 2		
----P0818367	1	P0818367	BLACK BEZEL FRAME FAIL LIGHT	1	0
----QD-HLMP2655	1	A0328413	DIODE LED RED LIGHT BAR HI EFF		
----R0106539	1	R0106539	HOOK-UP WIRE, SINGLE, UL 1430, CSA REW-105, 22AWG		
----R0107270	1	R0107270	HOOK-UP WIRE, SINGLE, UL 1007, CSA TR-64, 22AWG 7X		
----R0108049	1	R0108049	TAPE, POLYESTER 0.0025 THK X 0.200 WIDE, TEMP= 130		
----R0115628	0.01	R0115628	EPOXY ADHESIVE, COLOR: CLEAR, 2 COMPONENT, HIGH ST		
---NT9X9206	1	P0727916	RIGHT BULKHEAD	7	5
---NT9X9514	1	P0727917	RIGHT BULKHEAD BASE	8	6
---NT9X9515	1	P0727915	LEFT BULKHEAD BASE	7	6
---NT9X9533	1	P0729772	LEFT BULKHEAD	6	5
---NT9X9547	2	P0735467	LOGIC RETURN MOUNT	2	2
---NT9X9575	1	P0743861	C42 CABINET WELDMENT	3	3
---NTEX5024	1	B0234246	DUAL FSP CONNECTOR PANEL ASSY	3	1
----CRP14M050	8	A0317136	CONN ACCESSORY D SUB, 4-40 SCREWLOCK		
----FCP01C25NB50G	2	A0316601	CONN FILTER D SUB, 375 PF ADAPTER		
----P0682727	1	P0682727	SNAP BUSHING, MAT: NYLON, FIN: BLACK		
----P0731218	1	P0731218	DUAL FSP CONNECTOR PANEL	2	0
---NTRX1656	4	B0235784	INTERNATIONAL DOOR GROUND G/Y CABLE ASSEMBLY	1	1
----NPS50065-01L28	1	A0288183	CONN TERMINAL LUG RING PLAIN 12-10		
----NPS50065-13L19	1	A0288186	CONN TERMINAL LUG DISCONNECT PLAIN 12-10		
----R0115564	0.306	R0115564	10AWG (105X30), CU, XLPE INS, COLOR GREEN/YELLOW S		
--P0123753	4	P0123753	WASHER, FLAT METAL, .438 X 1.00 X 0.07"		
--P0125616	8	P0125616	CAP SCREW CAP SCREW		
--P0147284	4	P0147284	HEX HD CAP SCR, 0.375-16X1.250, STEEL (GR2), 289A		
--P0182960	4	P0182960	SPG LOCK WASHER		
--P0205651	10	P0205651	MACHINE SCREW MACHINE S		
--P0242132	10	P0242132	WASHER, SPRING HELICAL .168 X 0.296 X 0.040		
--P0387748	8	P0387748	WASHER, LOCK, 0.255 X 0.493 X 0.062		
--P0423633	4	P0423633	WASHER, LOCK TOOTH .168 X .381 X 0.023		
--P042B640	8	P042B640	MACH SCREW HEX HEAD (NO SLT) 0.164-32X 0.250		
--P0567295	8	P0567295	WASHER .281 X .625 X .065		
--P0575598	20	P0575598	TAPTITE TAPPING SCREW T		
--P0578123	20	P0578123	HWHTTSCR .164-32X.250 289A		
--P0627369	4	P0627369	HEX NUT & WASHER ASSY (KEPS)		
--P0631766	16	P0631766	RIVET, MATL CODE= S 289A FINISH, DIA= 0.125 0.425		
--P0673158	1	P0673158	FSP BLANKING PANEL		
--P0674562	16	P0674562	FRAME SHIM (SIDE)		
--P0689010	1	P0689010	SNAP BUSHING, MAT: NYLON, FIN: BLACK		
--P0719685	8	P0719685	DOMED HOLE PLUG, HOLE DIA: 1.625", PANEL THK: 0.03		
--P0727771	12	P0727771	SHELF SUPPORT BRACKET	5	0

---P0729753	2	P0729753	OUTER PANEL	7	0
---P0729945	1	P0729945	BONDING GASKET	3	0
---P0729946	2	P0729946	COOLING UNIT BULKHEAD	3	0
---P0736213	1	P0736213	GASKET, MESH, SHORT	1	0
---P0736214	1	P0736214	GASKET, MESH, LONG	1	0
---P0738839	2	P0738839	CABLE TUNNEL COVER	3	0
---P0738908	10	P0738908	CABLE TIE BRACKET FT STRUCT STEEL	1	0
---P0739160	2	P0739160	C42 BULKHEAD CABLE GUARD	1	0
---P0740444	2	P0740444	HINGE-BOTTOM, LH	4	0
---P0740446	2	P0740446	HINGE-BOTTOM, RH	4	0
---P0743156	1	P0743156	GASKET STRIP-FRONT	1	0
---P0743157	1	P0743157	GASKET STRIP-REAR	1	0
---P0743159	2	P0743159	TOP HINGE (CENTER LATCH DO OR)	1	0
---P0818367	1	P0818367	BLACK BEZEL FRAME FAIL LIGHT	1	0
---P097F811	8	P097F811	TAPPING SCREW		
---P097F813	80	P097F813	SCREW .216-24 X .500 STL 289A		
---P097G010	22	P097G010	TAPTITE TAP SCREW		
---P097Y566	4	P097Y566	TAPTITE TAPPING SCREW		
---P099E568	8	P099E568	WASHER		
---QD-HLMP2655	1	A0328413	DIODE LED RED LIGHT BAR HI EFF		
--P0065747	10	P0065747	HEX NUT		
--P0183220	6	P0183220	WASHER, LOCK, 0.221 X 0.475 X 0.028"		
--P0284154	6	P0284154	WASHER, FLAT MTL, 0.219 X 0.475 X 0.028		
--P0423632	20	P0423632	LOCK WASHER EXTERNAL TOOTH		
--P0452956	6	P0452956	SPCR(NON-MET) ROUND BODY 0.219ID 0.453OD 0.594LG		
--P0465953	20	P0465953	WASHER,FLAT(METALLIC),REGULAR, 0.156		
--P0559409	20	P0559409	THREADED FORMING SCREW, HEX WSHR HD TYPE TT, 0.138		
--P0610198	6	P0610198	SHOULDER BUSHING, NYLON		
--P0633700	7	P0633700	CABLE TIE, LOCKING. MAX BUNDLE DIAMETER: 0.87", LE		
--P0633701	12	P0633701	CABLE TIE, MAT: NYLON FLAME-RETARDANT, PLT1.5I-M6		
--P0633735	12	P0633735	CABLE TIE MOUNTING BASE		
--P0706928	8	P0706928	SHELF GASKET	2	0
--P0714754	1	P0714754	REAR SHELF IDENTICATION LABEL	2	0
--P0719278	6	P0719278	HEX WSHR HD, 0.164-32X1.0" STEEL, 289A		
--P0735782	1	P0735782	CM DESIGN STRIP (REAR)	1	0
--P0735784	1	P0735784	MS DESIGN STRIP (REAR)	1	0
--P0739090	1	P0739090	SHELF STRIP MS (REAR BOT)	3	0
--P0739091	1	P0739091	SHELF STRIP MS (REAR TOP)	3	0
--P0739092	1	P0739092	DESIGN STRIP MS (FRONT)	3	0
--P0739105	1	P0739105	SHELF STRIP CM/SLM (REAR BOT)	3	0
--P0739106	1	P0739106	SHELF STRIP CM/SLM (REAR TOP)	3	0
--P0739107	1	P0739107	DESIGN STRIP CM/SLM (FRONT)	3	0
--P0741224	1	P0741224	LABEL (UL/CSA) LISTED	4	0
--P0745670	2	P0745670	GASKET-BULKHEAD, C42	1	0
--P097F813	24	P097F813	SCREW .216-24 X .500 STL 289A		
--P097G010	172	P097G010	TAPTITE TAP SCREW		
--P097Y561	20	P097Y561	TOPTITE TAPPING SCREW		
--P097Y566	14	P097Y566	TAPTITE TAPPING SCREW		
--P097Y579	19	P097Y579	EXT TOOTH LOCKWASHER		
--QD-HLMP2655	1	A0328413	DIODE LED RED LIGHT BAR HI EFF		
--TBHDCN06001	1	A0368392	COVER, KIT, DOUBLE ROW, FLAT, 6 TERM, .88" WIDE, T		
-NT9X0436	1	B0231156	MS CLOCK CABLE ASSY NO.1	4	4
--CRP03S37PN50G	1	A0299063	CONN D SUB D ARRAY 0.109 PITCH AU MALE SOLDER CUP		
--CRP04G09T50G	3	A0361661	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE IDT 2426		
--CRP14M011	3	A0288282	CONN HOOD D SUB D-9ARRAY		
--CRP14M073	1	A0328575	CONN HOOD D SUB D-37 ARRAY		
--CX46PS003	1	A0361629	CONN COAX BNC TWINAX STRAIGHT PLUG CLAMP		
--R0105561	2	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA		
--R0113077	3	R0113077	HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE 0.500 0.025 UL		
--R0113085	75	R0113085	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246		
--R0114416	34	R0114416	SWITCHBOARD CABLE, 20AWG 7X28AWG 1 PAIR UL13 SN-CU		
-NT9X0437	1	B0231157	MS CLOCK CABLE ASSY NO.2	4	4
--CRP03G09T50G	1	A0361660	CONN D SUB D ARRAY 0.108 PITCH AU MALE IDT 2426		
--CRP03S37PN50G	1	A0299063	CONN D SUB D ARRAY 0.109 PITCH AU MALE SOLDER CUP		
--CRP04G09T50G	2	A0361661	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE IDT 2426		
--CRP14M003	1	A0279318	CONN HOOD D SUB D-9ARRAY		
--CRP14M011	2	A0288282	CONN HOOD D SUB D-9ARRAY		
--CRP14M073	1	A0328575	CONN HOOD D SUB D-37 ARRAY		
--CX46PS003	1	A0361629	CONN COAX BNC TWINAX STRAIGHT PLUG CLAMP		
--P0638259	2	P0638259	THREADED BUSHING		
--R0105561	2	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA		
--R0113077	3	R0113077	HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE 0.500 0.025 UL		
--R0113085	75	R0113085	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246		
--R0114416	34	R0114416	SWITCHBOARD CABLE, 20AWG 7X28AWG 1 PAIR UL13 SN-CU		
-NT9X0438	4	B0231158	CABLE ASSEMBLY NO.3 (COAX)	3	2
--CXB01PRT188174	1	A0360951	CONN COAX BNC RIGHT ANGLE PLUG CRIMP/SOLDER		
--CXB12PSTL31	1	A0360960	CONN COAX QLA STRAIGHT PLUG CRIMP/CRIMP		
--R0114349	42	R0114349	50 OHM COAXIAL CABLE, TYPE RG 188A/U		
-NT9X0810	1	B0231159	16K ENET SHELF ASSEMBLY	11	3
--NPS50394-03L2	2	A0326749	BUS BAR		
--NT9X0406	1	B0223461	CONN BACKPLANE CABLE ASSY	7	6
---CRC06M002	32	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU		
---CRC07HC20N00	2	A0322604	CONN STR HOUSING 2X10 ARRAY 0.100 PITCH NONE FEMAL		
---R0105561	0.25	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA		
---R0107948	4.877	R0107948	HOOK-UP WIRE, SINGLE, UL 1429, CSA AWMXLPVC, 24AWG		
--NT9X0408	1	B0223787	CABLE ASSY	7	6
---CRC06M002	32	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU		
---CRC07HC20N00	2	A0322604	CONN STR HOUSING 2X10 ARRAY 0.100 PITCH NONE FEMAL		
---R0105561	0.25	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA		
---R0107948	4.064	R0107948	HOOK-UP WIRE, SINGLE, UL 1429, CSA AWMXLPVC, 24AWG		
--NT9X0490	1	B0238936	E-CORE COMMON SHELF HAREWARE KIT	1	1
---P0668728	1	P0668728	LOWER CARD GUIDE	3	0
---P0668734	1	P0668734	UPPER PERSONALITY CARD GUIDE	4	0
---P0668735	1	P0668735	LOWER PERSONALITY CARD GUIDE	3	0
---P0668736	1	P0668736	FRONT UPPER EXTRUSION	1	0
---P0668737	1	P0668737	FRONT LOWER EXTRUSION	1	0
---P0668738	1	P0668738	REAR UPPER EXTRUSION	1	0
---P0668739	1	P0668739	REAR LOWER EXTRUSION	1	0
---P0668740	1	P0668740	REAR UPPER CARD GUIDE SCREEN	1	0
---P0668741	1	P0668741	REAR LOWER CARD GUIDE SCREEN	1	0
---P0669233	2	P0669233	SHELF REINFORCING ROD	1	0
---P0706864	2	P0706864	BACKPANEL BRACKET	4	0
---P0710461	1	P0710461	UPPER CARD GUIDE	6	0
---P0729861	2	P0729861	SHELF MOUNTING BRACKET	4	0
---P0729862	1	P0729862	LEFT SIDE PANEL	3	0
---P0729863	1	P0729863	RIGHT SIDE PANEL	3	0
---P0729871	2	P0729871	SHELF MOUNTING BRACKET	1	0
---P0744405	2	P0744405	END PLATE	1	0
---P0744408	2	P0744408	COVER PLATE	1	0
---P0744410	1	P0744410	LEFT SIDE CENTER SUPPORT	1	0
---P0744411	1	P0744411	RIGHT SIDE CENTER SUPPORT	3	0
--NT9X0811	1	B0231160	16K ENET BACKPANEL ASSY	3	1
---CFC22C16A06	2	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR		
---CTP21H184CNR1	18	A0326883	CONN NORCON, SHROUD 4X46 ARRAY 0.100 PITCH NONE MA		
---CTP21H360C	26	A0344714	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA		
---CTP21H360CNR1	8	A0325203	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA		
---NPS25230L18D	8396	A0354273	PCB PIN COMPLIANT		
---NPS25230L21D	964	A0354276	PCB PIN COMPLIANT		
---NT9X0812	1	P0710118	16K ENET BACKPANEL PCB	3	2
---P0183093	26	P0183093	LOCK WASHER		
---P0251628	4	P0251628	TAPPING SCREW TAPPING SCR S F PAN HEAD (SLTD) 0.11		

---P0639584	11	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010																	
---P0668582	36	P0668582	LATCH																	
---P0669306	52	P0669306	SOCKET HEAD CAP SCREW																	
---P0669307	26	P0669307	4X90 CONNECTOR GUIDE PIN																	
---P0669314	26	P0669314	4X90 CONNECTOR SOCKET GUIDE PIN																	
---P0669316	52	P0669316	POLARIZING KEY THREADED	1	0															
---P0669317	52	P0669317	4X90 CONNECTOR POLAR KEY-UNTHREAD	2	0															
---P0671051	36	P0671051	PLUG 4X46																	
--NT9X2824	2	B0238937	POWER CONVERTER BACKPANEL ASSEMBLY	1	1															
---CBR30B020S	2	A0299030	CONN TOP ENTRY 2X10 ARRAY 0.100 PITCH AU FEMALE ST																	
---CFC22C16A06	1	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR																	
---CTP20B48VNS6	2	A0319277	CONN STR RECEPT, P. DIN 3X16 ARRAY 0.200 PITCH AU																	
---CTP20B64VNS9	2	A0326973	CONN STR RECEPT, P. DIN 4X16 ARRAY 0.200 PITCH AU																	
---NT9X2827	1	P0742781	POWER CONVERTER BACKPLANE PCB (NT9X2827)	1	1															
---P0142036	3	P0142036	SCREW,PAN HEAD(MACH),SLOTTED, 0.138-32 X 0.625																	
---P0180686	8	P0180686	MACHINE SCREW MACH SCR S PAN HEAD SLOTTED 0.086-56																	
---P0182942	8	P0182942	LOCK WASHER																	
---P0183093	8	P0183093	LOCK WASHER																	
---P0298849	8	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56																	
---P0594346	3	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A																	
---P0639584	4	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010																	
---P0675200	2	P0675200	POST KEY																	
---P0675201	1	P0675201	POST TURRET																	
---P0675202	2	P0675202	KEYING POST																	
---P0675203	1	P0675203	CONNECTOR SHROUD																	
---P0675204	4	P0675204	CONNECTOR POST																	
---P099D274	2	P099D274	TAPPING SCREW TAPPING SCR S B PAN HEA																	
--NT9X6107	2	B0238940	INTERFACE PANEL ASSEMBLY	2	2															
---CRP04W09V651	1	A0608797	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP																	
---CRP14M002	1	A0279333	D SUB FEMALE SCREW LOCK																	
---FTB1X3A	1	A0605068	FILTERED TERMINAL BLOCK																	
---NT0X2706	1	B0238938	INTERFACE PANEL MECH. ASSEMBLY	1	1															
----P0639815	2	P0639815	STANDOFF SELF-CLINCH, INT THD, (PENN ENG. SOS-440-																	
----P0661462	2	P0661462	STANDOFF SELF-CLINCH, BLIND, 0.112-40, SS																	
----P0744409	1	P0744409	INTERFACE PLATE	2	0															
---NT1X6111	1	B0239629	POWER INTERFACE CP	1	1															
----CB18X7RA331K	9	A0274436	CAP CER AX 330PF 100V 10%																	
----CRP04L09PN	1	A0291697	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP																	
----CTP27P020VN	1	A0604987	CONN STR HEADER 2X10 ARRAY 0.100 PITCH AUPD M-M AD																	
----NT9X6108	1	P0742783	POWER INTERFACE PCB (NT9X6108)	1	2															
----P099D465	2	P099D465	SCREW, TYPE B PAN HD SLT, 0.112-24X0.188, STEEL, 2																	
----SPC13C9W3LD	2	A0604955	SW TOGGLE 2PDT (ON)-ON-(ON) W WRAP TERM																	
---P0180927	2	P0180927	PHM SCREW 0.112-40 X 0.500 X 0.219																	
---P0242824	2	P0242824	PHM SCR .112X40X1.375																	
---P0249752	2	P0249752	LOCK WASHER																	
---P0594316	2	P0594316	KEPS, PREASSEMBLED, HEX NUT & EXT LOCKWASHER .112																	
---P0594346	2	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A																	
---QD-HP4655	2	A0270192	DIODE LED RED																	
---R0114610	2	R0114610	EMI/RFI BERYLLIUM COPPER SLOTTED SHIELDING,SELF-AD																	
---SPC13C9W3LD	2	A0604955	SW TOGGLE 2PDT (ON)-ON-(ON) W WRAP TERM																	
--P0138380	4	P0138380	MACHINE SCREW MACHINE S																	
--P0242132	36	P0242132	WASHER, SPRING HELICAL .168 X 0.296 X 0.040																	
--P0284145	32	P0284145	WASHER																	
--P0559409	130	P0559409	THREADED FORMING SCREW, HEX WSHR HD TYPE TT, 0.138																	
--P0594346	48	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A																	
--P0627369	6	P0627369	HEX NUT & WASHER ASSY (KEPS)																	
--P0631766	10	P0631766	RIVET, MATL CODE= S 289A FINISH, DIA= 0.125 0.425																	
--P0633700	14	P0633700	CABLE TIE, LOCKING. MAX BUNDLE DIAMETER: 0.87", LE																	
--P0633746	4	P0633746	CABLE TIE MOUNTING BASE, SCREW MOUNT FOUR WAY, MAT																	
--P0668725	2	P0668725	CARD GUIDE EMI SCREEN	2	0															
--P0676101	48	P0676101	LOCK WASHER, EXT TOOTH, PHOSPHOR BRONZE FIN: 562A,																	
--P0678310	2	P0678310	SEE P0633725 AS POSSIBLE SUBSTITUTE																	
--P0706928	4	P0706928	SHELF GASKET	2	0															
--P0739099	1	P0739099	SHELF STRIP ENI (FRONT)	3	0															
--P097G010	98	P097G010	TAPTITE TAP SCREW																	
--P097Y561	16	P097Y561	TOPTITE TAPPING SCREW																	
--P099Q897	48	P099Q897	6-32 HEX NUT																	
--R0109727	3.178	R0109727	EMI GASKET MATL,RUBBER,DIA4.78MM(0.188")MONEL OVER																	
-NT9X12AD	2	B0224790	PORT CARD WITH PARITY	21	20			229.961												
--A0345721	1	A0345721	IC FTTL QUAD XOR (SM)					0.11	Philips Components	Texas Instruments	Fairchild Semiconductor									
--A0353008	4	A0353008	IC FTTL QUAD MUX 2 - 1 3S (SM)					0.138	Fairchild Semiconductor	Texas Instruments										
--A0354209	2	A0354209	IC BIPOLAR BUFF 10-BIT (SM)						Philips Components	Fairchild Semiconductor										
--CA07X6C100M050T	3	A0337004	CAP AL SMD 10.0UF 20.0% 50V 105C 6.80MM SIZE					0.045	Elna America Inc	United Chemicon Inc	Nichicon America Corp	Panasonic Industrial Co Circuit Custom Components)								
--CHC1206C0G331F5B	4	A0376349	CAP CER CHIP 330.0PF 1.00% 50.0V C0G 1206					0.021	Kemet Electronics	Syfer Technology Ltd	AVX	Corning Glass Works	Murata Manufacturing Co	Johanson Dielectrics Ltd	EPCOS AG	Yageo Corp	Samsung	TDK	Taiyo Yuden Inc	Vitramon Inc
--CHC1206X7R102K5B	2	A0344870	CAP CER CHIP 1.0NF 10.00% 50.0V X7R 1206					0.009	Kemet Electronics	Syfer Technology Ltd	AVX	Corning Glass Works		Johanson Dielectrics Ltd	EPCOS AG	Yageo Corp	Samsung	TDK	Taiyo Yuden Inc	Vitramon Inc
--CHC1206X7R104K5B	206	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206					0.012	Kemet Electronics	Syfer Technology Ltd	AVX		Murata Manufacturing Co	Johanson Dielectrics Ltd	EPCOS AG	Yageo Corp	Samsung	TDK	Taiyo Yuden Inc	Vitramon Inc
--CHR01A1001	39	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C					0.002	State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp				
--CHR01A1002	34	A0293769	RES FILM SMT 10.00 KOHM 0.125W 1.00% 100 PPM/C					0.002	State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp				
--CHR01A1212	1	A0292424	RES FILM SMT 12.10 KOHM 0.125W 1.00% 100 PPM/C					0.002	State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp				
--CHR01A1541	1	A0368657	RES FILM SMT 1.54 KOHM 0.125W 1.00% 100 PPM/C					0.002	State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp				
--CHR01A30R1	2	A0325352	RES FILM SMT 30.10 OHM 0.125W 1.00% 100 PPM/C					0.002	State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp				
--CHR01A5111	2	A0292428	RES FILM SMT 5.11 KOHM 0.125W 1.00% 100 PPM/C					0.002	State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp				
--CHR01B1100W	4	A0617322	RES FILM SMT 110.00 OHM 0.250W 1.00% 100 PPM/C					0.009		Dale Electronics Inc		Panasonic Industrial Co Circuit Custom Components)			KOA Speer Electronics Inc)					
--CHR01B1500W	1	A0601184	RES FILM SMT 150.00 OHM 0.250W 1.00% 100 PPM/C					0.01		Dale Electronics Inc		Panasonic Industrial Co Circuit Custom Components)			KOA Speer Electronics Inc)					
--CHR01B2210W	1	A0601183	RES FILM SMT 221.00 OHM 0.250W 1.00% 100 PPM/C					0.01		Dale Electronics Inc		Panasonic Industrial Co Circuit Custom Components)			KOA Speer Electronics Inc)					
--CHR05A4701	121	A0315362	RES FILM SMT 4.70 KOHM 0.125W 5.00% 200 PPM/C					0.001	State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp	International Resistive Co Inc)			
--CHR05A8200	1	A0314640	RES FILM SMT 820.00 OHM 0.125W 5.00% 200 PPM/C						State of the Art Inc	Dale Electronics Inc	AVX Corp	Panasonic Industrial Co Circuit Custom Components)	Roederstein Electronics Inc)	Rohm Electronics	KOA Speer Electronics Inc)	Yageo Corp	International Resistive Co Inc)			
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F					8.506	Framatome Connectors Canada											

-FUS45X0.062	1	A0382524	FUSE, FAST, SMD, 0.062A, 125VAC/DC, MOLDED, 2917 S						0.183	Littelfuse Inc	Cooper Industries Bussmann Division)						
-NT9V12AD	1	B0224798	PORT CARD WITH PARITY FIRMWARE		9	5											
--QM28SCID04-90CH5	1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION						2.8	Atmel Corp (Discont)							
--QM28SCID04-90CH514SX	1	A0636043	PROGRAMMED DEVICE FOR THE NT9V12AD			1				No Data in partsmart							
--QMGAL16V8-10LCT5	1	A0380047	MICROCIRCUIT, CMOS PROGRAMMABLE						0.475	Lattice Semiconductor Corp)	Cypress Semiconductor Corp)						
--QMGAL16V8-10LCT503RR	1	A0629698	PROGRAMMED DEVICE FOR NT9X12AD			2				No Data in partsmart							
--QMPALCE22V10H-15CT5	7	A0352108	IC EECMOS PAL 15NS (SM)						0.675	Lattice Semiconductor Corp)	Cypress Semiconductor Corp)	Philips Components	Atmel Corp				
--QMPALCE22V10H-15CT5(	1	A0629691	PROGRAMMED DEVICE FOR NT9X12AD	R		1				No Data in partsmart							
FN																	
--QMPALCE22V10H-15CT5(	1	A0629692	PROGRAMMED DEVICE FOR NT9X12AD	R		1				No Data in partsmart							
FP																	
--QMPALCE22V10H-15CT5(	1	A0629693	PROGRAMMED DEVICE FOR NT9X12AD	R		1				No Data in partsmart							
FQ																	
--QMPALCE22V10H-15CT5(	1	A0629694	PROGRAMMED DEVICE FOR NT9X12AD	R		1				No Data in partsmart							
FR																	
--QMPALCE22V10H-15CT5(	1	A0629695	PROGRAMMED DEVICE FOR NT9X12AD	R		1				No Data in partsmart							
FS																	
--QMPALCE22V10H-15CT5(	1	A0629696	PROGRAMMED DEVICE FOR NT9X12AD	R		1				No Data in partsmart							
FT																	
--QMPALCE22V10H-15CT5(	1	A0629697	PROGRAMMED DEVICE FOR NT9X12AD	R		2				No Data in partsmart							
FU																	
-NT9X1204	1	P0604909	PORT CARD WITH PARITY PCB		2	3				DaeDuck Electronics Co Ltd)							
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI						0.077	Framatome Connectors Canada							
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156						0.208	Framatome Connectors Canada							
--P0668764	2	P0668764	FRONT LATCH						0.366	Brock Telecom Limited)	SCI Systems Inc	Oneida Molded Plastics)	Nikom Electronics Corp)	Golden Enterprises)	Duramold Plastics Inc)		
--P0668766	1	P0668766	FRONT FACEPLATE						1.7	Brock Telecom Limited)	SCI Systems Inc	Oneida Molded Plastics)		Golden Enterprises)		Newport Technology Inc	BMP Metal Inc
--P0675738	1	P0675738	LOGIC CARD CENTER LABEL		2	0				No Data in partsmart							
--P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI						0.079	Process Products Ltd)	Century Fasteners Corp)						
--P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH						0.029	Fastbolt Corp)		Townsend					
--P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH						0.017	Fastbolt Corp)	Century Fasteners Corp)	Townsend	C-MAC Network Systems Inc				
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1.		2	0			0.056	Instrument Specialties Co Inc)	Connor Formed Metal products)	Irwin Industrial Agencies Ltd	Commercial Spring & Tool Co Ltd	Golden Enterprises	Newport Technology Inc	SCI Systems Inc	
--P0719254	2	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688						0.008	Century Fasteners Corp)							
--P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER		5	0			7.792	Precision Machine Fabrication Inc	Chicago White Metal Casting Inc						
-QD-BZX84C3V3	1	A0322396	DIO ZENER 3.3V 0.3W SURFACE						0.018	Philips Components	Zetex Inc	ON Semiconductor Semiconductor Components Ind L)	General Semiconductor Inc)				
-QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO						0.064	Littelfuse Inc	(San-O Industrial Corp)	Cooper Industries Bussmann Division	Bel Fuse Inc	Wickmannwerke Gmbh)			
-QM-DS1000Z-100H5	5	A0604952	MICROCIRCUIT, CMOS, DELAY LINE, 5-TAP, TOTAL DELAY						1.79	Dallas Semiconductor Corp)							
-QM6264-35T5	10	A0354308	MEMORY IC, CMOS SRAM, 8KX8, 35NS, SOJ28(300MIL)						1	Samsung Semiconductor & Telecommunication)	Cypress Semiconductor Corp)	Integrated Device Technology)					
-QM6287-25T5	5	A0361945	MEMORY IC, CMOS SRAM, 64KX1, 25NS, SOJ24, SEP I/O						1.6	Cypress Semiconductor Corp)	Hitachi America Ltd Semiconductor & IC Division)						
-QM74ACT821H5	18	A0346779	MC						0.75	Fairchild Semiconductor)							
-QM74ALS00H5	6	A0329229	IC ALSTTL QUAD NAND (SM)						0.094	Philips Components	Texas Instruments	Fairchild Semiconductor	Arrow				
-QM74ALS02H5	2	A0344994	MC						0.098	Texas Instruments	Philips Components	Fairchild Semiconductor					
-QM74ALS04H5	11	A0329233	IC ALSTTL HEX INV (SM)						0.094	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS08H5	13	A0329230	IC ALSTTL QUAD AND (SM)						0.093	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS10H5	1	A0344993	MC						0.094	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS11H5	1	A0346787	MC						0.094	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS139H5	2	A0344998	MC						0.143	Philips Components	Texas Instruments						
-QM74ALS164H5	2	A0351465	MICROCIRCUIT, ADVANCED LOW POWER SCHOTTKY, STATIC						0.22	Philips Components	Texas Instruments						
-QM74ALS174H5	4	A0353109	MC						0.166	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS175H5	4	A0353015	MC						0.166	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS244H5	12	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)						0.175		Texas Instruments	Fairchild Semiconductor					
-QM74ALS245H5	10	A0329224	IC ALSTTL OCTAL BUS XCVR 3S (SM)						0.174	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS253H5	2	A0353019	MC						0.205	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS273H5	1	A0329226	IC ALSTTL OCTAL FF D (SM)						0.176	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS32H5	7	A0329228	IC ALSTTL QUAD OR (SM)						0.096	Philips Components	Texas Instruments	Fairchild Semiconductor					
-QM74ALS374H5	5	A0329222	IC ALSTTL OCTAL FF D 3S (SM)						0.175		Texas Instruments	Fairchild Semiconductor					
-QM74ALS74H5	9	A0329223	IC ALSTTL DUAL FF D 3S (SM)						0.105	Philips Components	Texas Instruments	Fairchild Semiconductor					

-QM74ALS86H5	1	A0351464	MICROCIRCUIT, ADVANCED LOW POWER SCHOTTKY, GATE					0.119	Philips Components	Texas Instruments	Fairchild Semiconductor			
-QM74F04H5	2	A0344794	HEX INVERTER					0.08			Fairchild Semiconductor	(Arrow Electronique Sa) (local supplier)		
-QM74F08H5	3	A0344795	MC					0.079	Philips Components	Texas Instruments	Fairchild Semiconductor	(Arrow Electronique Sa) (local supplier)		
-QM74F11H5	1	A0353769	MC					0.079	Philips Components	Texas Instruments	Fairchild Semiconductor			
-QM74F125H5	2	A0345720	MC					0.12	Philips Components	Texas Instruments	Fairchild Semiconductor			
-QM74F132H5	1	A0377509	IC FTTL QUAD NAND SCHMITT TRIGGER (SM)						Philips Components		Fairchild Semiconductor			
-QM74F138H5	5	A0344821	MC					0.13	Philips Components	Texas Instruments	Fairchild Semiconductor			
-QM74F139H5	2	A0337024	MC					0.128	Philips Components		Fairchild Semiconductor			
-QM74F14H5	1	A0353777	MC					0.106			Fairchild Semiconductor	Arrow		
-QM74F163H5	3	A0344798	MC					0.17	Philips Components	Texas Instruments	Fairchild Semiconductor			
-QM74F240H5	1	A0325315	IC FTTL OCTAL BUFF INV 3S (SM)					0.154	Philips Components	Texas Instruments	Fairchild Semiconductor	Arrow (local)		
-QM74F244H5	6	A0344819	IC, FTTL, OCTAL DRIVER					0.153	Philips Components		Fairchild Semiconductor	Arrow (local)	National Semiconductor Gmbh	
-QM74F245H5	4	A0346784	MC					0.147	Philips Components	Texas Instruments	Fairchild Semiconductor			
-QM74F253H5	1	A0346783	MC					0.138	Philips Components	Texas Instruments	Fairchild Semiconductor			
-QM74F269H5	2	A0353429	MC					0.8	Philips Components		Fairchild Semiconductor			
-QM74F280H5	11	A0346029	MC					0.15			Fairchild Semiconductor	Arrow (local)		
-QM74F32H5	3	A0344796	MC					0.081	Philips Components	Texas Instruments	Fairchild Semiconductor	(Arrow Electronique Sa) (local supplier)		
-QM74F373H5	11	A0344820	MC					0.15	Philips Components	Texas Instruments	Fairchild Semiconductor	(Arrow Electronique Sa) (local supplier)		
-QM74F521H5	1	A0345095	MC					0.215	Philips Components	Texas Instruments	Fairchild Semiconductor	(Arrow Electronique Sa) (local supplier)		
-QM74F579H5	6	A0367122	IC FTTL 8-BIT BINARY COUNTER (SM)						Philips Components		Fairchild Semiconductor		SCI Systems Inc	
-QM74F74H5	4	A0322324	IC FTTL DUAL FF D (SM)					0.092	Philips Components	Texas Instruments	Fairchild Semiconductor	(Arrow Electronique Sa) (local supplier)		
-QM74F85H5	1	A0329259	IC FTTL COMPARATOR 4-BIT MAG (SM)					0.44	Philips Components			(Arrow Electronique Sa) (local supplier)		
-QM74LS125H5	3	A0369311	IC LSTTL QUAD BUFF 3S (SM)					0.14		Texas Instruments	Fairchild Semiconductor			ON Semiconductor Semiconductor Components Ind L)
-QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)					0.254	STMicroelectronics Incorporated)	Texas Instruments				
-QMV156-1DF5	1	A0619972	LINK HANDLER,N05, FREE LEAD VERSUION, PQFP100						STMicroelectronics Incorporated)					
-QMV165-1FF5	1	A0619973	BUS ACCESS CIRCUIT,N04, FREE LEAD VERSION, PQFP128						STMicroelectronics Incorporated)					
-QT-MMBT2369	1	A0320800	TRANSISTOR NPN 15VCE 0.2A SMD					0.023	Zetex Inc	Philips Components	Fairchild Semiconductor	ON Semiconductor Semiconductor Components Ind L)		
-NT9X15AA	2	B0221841	MAPPER CIRCUIT PACK	26	50									
-A0344797	3	A0344797	IC FTTL QUAD FF D (SM)											
-A0345721	2	A0345721	IC FTTL QUAD XOR (SM)											
-A0353424	1	A0353424	IC ALSTTL DUAL FF D 4-BIT (SM)											
-CA07X8C470M016T	2	A0337006	CAP AL SMD 47.0UF 20.0% 16V 105C 6.80MM SIZE											
-CHC1206C0G220J5B	32	A0368181	CAP CER CHIP 22.0PF 5.00% 50.0V C0G 1206											
-CHC1206X7R104K5B	184	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206											
-CHR01A1000	32	A0312154	RES FILM SMT 100.00 OHM 0.125W 1.00% 100 PPM/C											
-CHR01A1001	6	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C											
-CHR01A10R0	14	A0325354	RES FILM SMT 10.00 OHM 0.125W 1.00% 100 PPM/C											
-CHR01A20R0	40	A0325355	RES FILM SMT 20.00 OHM 0.125W 1.00% 100 PPM/C											
-CHR01A3321	192	A0321070	RES FILM SMT 3.32 KOHM 0.125W 1.00% 100 PPM/C											
-CHR01A33R2	51	A0329369	RES FILM SMT 33.20 OHM 0.125W 1.00% 100 PPM/C											
-CHR01B1500W	1	A0601164	RES FILM SMT 150.00 OHM 0.250W 1.00% 100 PPM/C											
-CHR01B33R2W	20	A0617324	RES FILM SMT 33.20 OHM 0.250W 1.00% 100 PPM/C											
-CHR05A1501	1	A0314644	RES FILM SMT 1.50 KOHM 0.125W 5.00% 200 PPM/C											
-CHR11A0000	4	A0296797	RES FILM SMT 0.0 OHM (JUMPER) 2 AMP MAX											
-CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F											
-FUS45X5.0	1	A0378482	FUSE, FAST, SMD, 5.0A, 125VAC/DC, MOLDED, 2917 SIZ											
-NT9V15AA	1	B0233360	MAPPER CP FIRMWARE	8	6									
--QM28SCID04-90CH5	1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION											
--QM28SCID04-90CH503RN	1	A0636119	PROGRAMMED DEVICE FOR NT9V15AA		1									
--QMGAL16V8A-15LCT5	1	A0378822	PLCC20,16/8PRGM,15NS,MACROCELL											
--QMGAL16V8A-15LCT503P	1	A0629873	PROGRAMMED DEVICE FOR NT9X15AA	B	1									
--QMPALCE22V10H-15CT5	2	A0352108	IC EECMOS PAL 15NS (SM)											
--QMPALCE22V10H-15CT5	1	A0629874	PROGRAMMED DEVICE FOR NT9X15AA	R	1									
--QMPALCE22V10H-15CT5	1	A0629875	PROGRAMMED DEVICE FOR NT9X15AA	R	1									
-NT9X1501	1	P0661244	MAPPER PCB	7	7									
-P0183093	1	P0183093	LOCK WASHER											
-P0298849	1	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56											
-P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI											
-P0668561	2	P0668561	KEY OCTAGON FOR A0324156											
-P0668764	2	P0668764	FRONT LATCH											
-P0668766	1	P0668766	FRONT FACEPLATE											
-P0675738	1	P0675738	LOGIC CARD CENTER LABEL	2	0									
-P0682710	2	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)											
-P0691810	1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344											
-P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI											
-P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH											
-P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH											
-P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0									
-P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER	5	0									
-QM41C4000-60ST5	19	A0378423	MEMORY IC, CMOS DRAM, PAGE 5V, 4MX1, 60NS, SOJ26/2											
-QM74ALS00H5	4	A0329229	IC ALSTTL QUAD NAND (SM)											
-QM74ALS02H5	2	A0344994	MC											
-QM74ALS04H5	9	A0329233	IC ALSTTL HEX INV (SM)											
-QM74ALS08H5	3	A0329230	IC ALSTTL QUAD AND (SM)											
-QM74ALS109H5	5	A0353011	MC											
-QM74ALS10H5	2	A0344993	MC											
-QM74ALS163H5	4	A0345722	SYNCHRONOUS 4 BIT COUNTER											
-QM74ALS175H5	1	A0353015	MC											
-QM74ALS20H5	1	A0329234	IC ALSTTL DUAL NAND 4-IN (SM)											
-QM74ALS244H5	10	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)											
-QM74ALS257H5	6	A0329227	IC ALSTTL QUAD MUX 2 - 1 3S (SM)											
-QM74ALS30H5	1	A0344997	MC											
-QM74ALS32H5	5	A0329228	IC ALSTTL QUAD OR (SM)											
-QM74ALS374H5	11	A0329222	IC ALSTTL OCTAL FF D 3S (SM)											
-QM74ALS521H5	3	A0353106	MC											
-QM74F00H5	5	A0344991	LOGIC, FAST, QUAD 2-INPUT NAND GATE											
-QM74F02H5	2	A0346033	MC											
-QM74F04H5	1	A0344794	HEX INVERTER											
-QM74F08H5	1	A0344795	MC											
-QM74F109H5	11	A0337252	IC											
-QM74F10H5	4	A0337023	MC											

--QM74F125H5	1	A0345720	MC																	
--QM74F138H5	2	A0344821	MC																	
--QM74F14H5	2	A0353777	MC																	
--QM74F163H5	1	A0344798	MC																	
--QM74F20H5	4	A0345060	MC																	
--QM74F244H5	11	A0344819	IC, FTTL, OCTAL DRIVER																	
--QM74F253H5	18	A0346783	MC																	
--QM74F280H5	12	A0346029	MC																	
--QM74F32H5	1	A0344796	MC																	
--QM74F374H5	7	A0344990	MC																	
--QM74F377H5	1	A0367125	IC FTTL OCTAL FF D (SM)																	
--QM74F38H5	1	A0329260	IC FTTL QUAD NAND BUFF OC (SM)																	
--QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)																	
-NT9X17AD	2	B0234173	MS 4 PORT CARD CP	20	20															
--A0355422	4	A0355422	MICRO CIRCUIT (SEMI CUS) LINK HANDLER GATE ARRAY						STMicroelectronics Incorporated											
--CA14X100M050S	1	A0285220	CAP AL AX 10.0UF 20.000% 50.0V 85C					0.07	Nichicon America Corp											
--CA14X470M010S	1	A0291583	CAP AL AX 47.0UF 20.000% 10.0V 85C						Nichicon America Corp	BC Components										
--CA14X4R7M050S	1	A0293012	CAP AL AX 4.7UF 20.000% 50.0V 85C					0.056	Nichicon America Corp	BC Components										
--CB17X7RB104J	86	A0271564	CAP CER AX 100.0NF 5.0% 50.0V X7R 5.080MM LONG					0.033	AVX Avio Excelente SA DE CV	Kemet Electronics										
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F					8.506	Frametome Connectors Canada											
--NR12Q16B1001G	6	A0255715	RES, NETWORK, 1000.000 OHMS .100 POWER, 2.00 TOL					0.149	Dale Electronics Inc	Bourns Inc Trimpot Products Division	BI Technologies Corp C/O Pipe Thompson Technologies									
--NR13Q16J221331G	1	A0264249	RES NETWORK 220/330 OHM X 14 .125W 2%						Dale Electronics Inc	Bourns Inc Trimpot Products Division	BI Technologies Corp C/O Pipe Thompson Technologies									
-NT9V17AD	1	B0234174	MS 4 PORT CARD FIRMWARE	6	4				Nortel Prod											
--A0367231	2	A0367231	IC CMOS PAL 25NS					0.67	International Cmos Technology	Lattice Semiconductor Corp										
--QM27C256-20D1	1	A0329509	MEMORY IC, CMOS UVEPROM, 32KX8, 200NS, DIL28					1.35	Toshiba America Electronic Components Inc	Microchip Technology Inc	Advanced Micro Devices Inc AMD	Fairchild Semiconductor	STMicroelectronics Incorporated							
--QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16					0.7			Advanced Micro Devices Inc AMD									
--QMGAL16V8-15LCP5	1	A0376277	EECMOS PROGRAMMABLE DEVICE,15 NS						Lattice Semiconductor Corp	Cypress Semiconductor Corp										
---TT03JEX	1	A0396352	PROGRAMMED DEVICE		1				Nortel Prod											
---TT03JGW	1	A0393053	PROGRAMMED DEVICE		2				Nortel Prod											
---TT03JGX	1	A0393054	PROGRAMMED DEVICE		1				Nortel Prod											
---TT03JGY	1	A0393055	PROGRAMMED DEVICE		1				Nortel Prod											
---TT03JNW	1	A0398235	PROGRAMMED DEVICE		1				Nortel Prod											
-NT9X1705	1	P0730681	MS 4 PORT CARD PCB	3	3				DeeDuck Electronics Co Ltd											
--P0183093	1	P0183093	LOCK WASHER					0.005	Townsend	Fastbolt Corp	Century Fasterners Corp	TR Fastenings Ltd								
--P0298849	1	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56					0.006	Mcmastercarr Supply Co	Fastbolt Corp	Century Fasterners Corp	Townsend	Spaenaur Inc							
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI					0.006	Mcmastercarr Supply Co	Fastbolt Corp	Century Fasterners Corp	Townsend	Spaenaur Inc							
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156					0.208	Frametome Connectors Canada											
--P0668764	2	P0668764	FRONT LATCH					0.366	Brock Telecom Limited	SCI Systems Inc	Oneida Molded Plastics	Nikom Electronics Corp	Golden Enterprises	Duramold Plastics Inc						
--P0668766	1	P0668766	FRONT FACEPLATE					1.7	Newport Technology Inc	Brock Telecom Limited	SCI Systems Inc	Oneida Molded Plastics	BMP Metals Inc	Golden Enterprises						
--P0675738	1	P0675738	LOGIC CARD CENTER LABEL	2	0				No data in partsmart											
--P0691810	1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344						Process Products Ltd	Fastbolt Corp	Direct Fasteners Ltd	Century Fasteners Corp								
--P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI					0.079	Process Products Ltd	Century Fasteners Corp		Century Fasteners Corp								
--P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH					0.029	Fastbolt Corp	Townsend										
--P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH					0.017	Fastbolt Corp	Townsend	Century Fasteners Corp									
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1.	2	0			0.056	Instrument Specialties Co Inc	Connor Formed Metal products										
--P0719254	2	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688					0.008	Century Fasteners Corp											
--P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER	5	0			7.792	Precision Machine Fabrication Inc	Chicago White Metal Casting Inc										
--QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO					0.084	Littelfuse Inc	San-O Industrial Corp	Cooper Industries Bussmann Division	Bel Fuse Inc	Wickmannwerke Gmbh							
--QM100DLP5	1	A0262491	IC DELAY LINE DIGITAL 5 EQUAL TAPS 20 TO 100 NS					1.547	JBM Electronics Inc	Technitrol Ltd	Bel Fuse Inc	FEE Filmag								
--QM50DLP5	1	A0276161	IC DELAY LINE DIGITAL 5 EQUAL TAPS 10 TO 50 NS					1.32	JBM Electronics Inc	Technitrol Ltd	Bel Fuse Inc	FEE Filmag								
--QM6168-35P5	28	A0322246	MEMORY IC, CMOS SRAM, 4KX4, 35NS, DIL20						Cypress Semiconductor Corp	Integrated Device Technology	Matra Harris Semiconductor	Integrated Device Technology								
--QM62256L-10P5	1	A0345670	MEMORY IC, CMOS SRAM, 32KX8, 100NS, DIL28(600MIL)					1.628	Smos	Toshiba America Electronic Components Inc	NEC Electronics Inc	Cypress Semiconductor Corp	Mitsubishi Electric and Electronics USA Inc	Hyundai Electronics America	Sony Corp Of America					
--QM74ALS02P5	2	A0291652	IC ALSTTL QUAD NOR					0.096	Philips Components	Fairchild Semiconductor	Texas Instruments									
--QM74ALS04P5	6	A0292332	IC ALSTTL HEX INV					0.092	Philips Components	Texas Instruments	Fairchild Semiconductor									
--QM74ALS08P5	1	A0292333	IC ALSTTL QUAD AND					0.093	Philips Components	Texas Instruments	Fairchild Semiconductor									
--QM74ALS109P5	3	A0292264	IC ALSTTL DUAL FF JK					0.172		Texas Instruments	Fairchild Semiconductor									
--QM74ALS138P5	4	A0291866	IC ALSTTL DEMUX 3 - 8					0.166	Philips Components	Texas Instruments	Fairchild Semiconductor									
--QM74ALS139P5	1	A0312254	IC ALSTTL DUAL DEMUX 2 - 4					0.167	Philips Components	Texas Instruments										
--QM74ALS163P5	1	A0293672	IC ALSTTL COUNTER 4-BIT BIN					0.192	Philips Components	Texas Instruments	Fairchild Semiconductor									
--QM74ALS175P5	1	A0291865	IC ALSTTL QUAD FF D					0.175	Philips Components	Texas Instruments	Fairchild Semiconductor									
--QM74ALS240P5	1	A0292337	IC ALSTTL OCTAL BUFF INV					0.175	Philips Components	Texas Instruments	Fairchild Semiconductor									
--QM74ALS244P5	11	A0292062	IC ALSTTL OCTAL BUFF 3S					0.175		Texas Instruments	Fairchild Semiconductor									
--QM74ALS245P5	2	A0292063	IC ALSTTL OCTAL BUS XCVR 3S					0.173	Philips Components	Texas Instruments	Fairchild Semiconductor									

-QM74ALS251P5	1	A0320568	IC ALSTTL MUX 8 - 1 3S					0.158	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74ALS273P5	1	A0311969	IC ALSTTL OCTAL FF D					0.176	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74ALS27P5	1	A0292335	IC, LOGIC, ALSTTL TRIPLE NOR 3-IN					0.098	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74ALS32P5	2	A0291654	IC ALSTTL QUAD OR					0.096	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74ALS373P5	5	A0297219	IC ALSTTL OCTAL LATCH D 3S					0.19		Texas Instruments	Fairchild Semiconductor									
-QM74ALS374P5	17	A0292054	IC ALSTTL OCTAL FF D 3S					0.175		Texas Instruments	Fairchild Semiconductor									
-QM74ALS38P5	4	A0298724	IC ALSTTL QUAD NAND BUFF OC							Texas Instruments	Fairchild Semiconductor									
-QM74ALS521P5	2	A0318482	IC ALSTTL COMPARATOR 8-BIT					0.422		Texas Instruments	Fairchild Semiconductor									
-QM74ALS874P5	4	A0293739	IC ALSTTL DUAL FF D 4-BIT					0.58		Texas Instruments	Fairchild Semiconductor									
-QM74F00P5	2	A0277832	IC FTTL QUAD NAND					0.084	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F04P5	4	A0287319	IC FTTL HEX INV					0.064	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F08P5	2	A0287318	IC FTTL QUAD AND					0.064	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F109P5	3	A0291286	IC FTTL DUAL FF JK					0.132	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F10P5	2	A0277833	IC FTTL TRIPLE NAND 3-IN					0.079	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F125P5	1	A0345645	MC					0.123	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F138P5	1	A0291288	IC FTTL DEMUX 3 - 8					0.128	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F139P5	1	A0291289	IC FTTL DUAL DEMUX 2 - 4					0.128	Philips Components		Fairchild Semiconductor									
-QM74F14P5	1	A0329401	MC					0.108			Fairchild Semiconductor									
-QM74F163-1P5	3	A0627567	IC FTTL 4-BIT BINARY COUNTER. (SPECIAL FOR USE ON								Fairchild Semiconductor									
-QM74F175P5	1	A0291293	IC FTTL QUAD FF D					0.142	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F20P5	1	A0287316	IC FTTL DUAL NAND 4-IN						Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F240P5	2	A0290926	IC FTTL OCTAL BUFF INV 3S						Philips Components		Fairchild Semiconductor									
-QM74F244P5	9	A0290927	IC FTTL OCTAL BUFF 3S					0.153	Philips Components		Fairchild Semiconductor									
-QM74F257P5	2	A0287308	IC FTTL QUAD MUX 2 - 1 3S					0.14		Texas Instruments	Fairchild Semiconductor									
-QM74F260P5	1	A0346142	IC, FTTL, GATE						Philips Components	Texas Instruments										
-QM74F273P5	2	A0337052	IC					0.148	Philips Components		Fairchild Semiconductor									
-QM74F280P5	13	A0291294	IC FTTL PARITY GENERATOR 9-BIT					0.154			Fairchild Semiconductor									
-QM74F32P5	5	A0287315	IC FTTL QUAD OR					0.085	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F374P5	7	A0287311	IC FTTL OCTAL FF D 3S					0.155	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F521P5	1	A0314675	IC FTTL COMPARATOR 8-BIT					0.215	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74F579P5	1	A0370205	IC FTTL 8-BIT BINARY COUNTER						Philips Components		Fairchild Semiconductor									
-QM74F64P5	1	A0297228	IC FTTL AOI 4-2-3-2-IN								Fairchild Semiconductor									
-QM74F85P5	2	A0316947	IC FTTL COMPARATOR 4-BIT MAG					0.44	Philips Components											
-QM74F86P5	1	A0291285	IC FTTL QUAD XOR					0.106	Philips Components	Texas Instruments	Fairchild Semiconductor									
-QM74HCT00P5	1	A0323803	IC HCMOS QUAD NAND					0.09	Philips Components	Texas Instruments	Fairchild Semiconductor	STMicroelectronics Incorporated								
-QM74HCT04P5	1	A0315251	IC HCMOS HEX INV						Philips Components	Toshiba America Electronic Components Inc	Texas Instruments	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor	STMicroelectronics Incorporated						
-QM80C31BH1-16P5	1	A0636041	IC, CMOS, MICROCONTROLLER, 8-BIT/16MHZ, 0° C TO 70						Intel Corp											
-QMTL7702AE5	1	A0327091	MICROCIRCUIT, LINEAR SUPPLY VOLTAGE SUPERVISOR					0.247	STMicroelectronics Incorporated	Texas Instruments										
-QMV165FL5	4	A0352324	N04						STMicroelectronics Incorporated											
-QNM1100A21	1	A0276557	IC CRYSTAL OSCILLATOR 6.000MHZ						Champion Technologies Inc	Anderson Electronics Inc	CTS Corporation Frequency Control Division	Bliley Electric Co	Toyocom USA Inc	Connor Winfield Corp	Saronix					
-QT-MPQ2907	1	A0310879	XSTR PNP ARRAY 40V 0.6A THRU-HOLE						No suppliers in partsmart											
-RF06BW1001F	5	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL					0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd					
-RF06BW1501F	1	A0255782	RES, FILM, 1500.000 OHMS .250 POWER, 1.00 TOL					0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd					
-RF06BW2000F	4	A0265137	RES FILM 200.00 OHMS .250W 1.0%					0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd					
-RF06BW3010F	1	A0271887	RES FILM 301.00 OHMS .250W 1.0%					0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd	Ark-Les Inc				
-RF06BW4751F	1	A0258297	RES, FILM, 4750.000 OHMS .250 POWER, 1.00 TOL					0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd					
-SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION					0.025	Robinson Nugent Inc	Framatome Connectors USA Inc	Thomas & Betts Corp									
-SCT01B320	1	A0284937	SOCKET DIP 20 POSITION,RIGID INSULATION					0.039	Robinson Nugent Inc	Framatome Connectors USA Inc	Thomas & Betts Corp									
-SCT01B324	2	A0323911	SOCKET DIP 24 POSITION,RIGID INSULATION					0.046	Robinson Nugent Inc		Thomas & Betts Corp									
-SCT01B628	1	A0286209	SOCKET DIP 28 POSITION,RIGID INSULATION					0.033	Robinson Nugent Inc	Framatome Connectors USA Inc	Thomas & Betts Corp									
-SIC13B085Q1	4	A0360627	SOCKET PGA 85 POSITION,REMOVABLE INSULATION						Advanced Interconnections Corporation		Thomas & Betts Corp									
-SIC13B121Q1	4	A0360630	SOCKET PGA 121 POSITION,REMOVABLE INSULATION					1.092	Advanced Interconnections Corporation		Thomas & Betts Corp									
-NT9X21AB	2	B0231611	BUS TERMINATOR PADDLE BOARD CP	12	10															
-CA14X150M025S	1	A0279453	CAP AL AX 15.0UF 20.000% 25.0V 85C																	
-CB17X7RA104K	13	A0252189	CAP CER AX 100.0NF 10.0% 50.0V X7R 5.080MM LONG																	
-CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F																	
-NR12Q16B1001G	1	A0255715	RES, NETWORK, 1000.000 OHMS .100 POWER, 2.00 TOL																	
-NT9V21AB	1	B0231775	BUS TERMINATOR PADDLEBOARD CP FIRMWARE	3	2															
--QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16																	
--QM6331L-55P503HAE	1	A0372013	PROGRAMMED DEVICE		1															
--QMGAL16V8-15LCP5	1	A0376277	EECMOS PROGRAMMABLE DEVICE,15 NS																	

--TT03KHY		1	A0405151	PROGRAMMED DEVICE		1
-NT9X2102		1	P0711892	BUS TERMINATOR PB PCB	2	3
--P0183093		5	P0183093	LOCK WASHER		
--P0298849		5	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
--P0552373		2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR		
--P0668559		2	P0668559	4X90 MOUNTING BLOCK		
--P0668560		2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
--P0668561		2	P0668561	KEY OCTAGON FOR A0324156		
--P0668769		2	P0668769	INSERTION AID		
--P0675223		1	P0675223	FACEPLATE		
--P0676546		1	P0676546	REAR LATCH		
--P0676696		1	P0676696	REAR UPPER LATCH		
--P0691810		1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344		
--P0703914		7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0
--P0714987		1	P0714987	HSI SHEAR PLATE	2	1
--P0719254		6	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688		
--QFF4A6		1	A0259506	FUSE, FAST, AX, 4A, 125V, PICO		
--QM74ALS373P5		1	A0297219	IC ALSTTL OCTAL LATCH D 3S		
--QM74ALS521P5		1	A0318482	IC ALSTTL COMPARATOR 8-BIT		
--QM74F04P5		1	A0287319	IC FTTL HEX INV		
--QM74F11P5		1	A0287317	IC FTTL TRIPLE AND 3-IN		
--QM74F138P5		1	A0291288	IC FTTL DEMUX 3 - 8		
--QM74F244P5		5	A0290927	IC FTTL OCTAL BUFF 3S		
--QM74F245P5		1	A0290928	IC FTTL OCTAL BUS XCVR 3S		
--RF06BW1100F		9	A0244608	RES, FILM, 110.000 OHMS .250 POWER, 1.00 TOL		
--RF06BW1210F		2	A0255989	RES, FILM, 121.000 OHMS .250 POWER, 1.00 TOL		
--RF06BW1300F		1	A0271737	RES FILM 130.00 OHMS .250W 1.0%		
--RF06BW1500F		6	A0271764	RES FILM 150.00 OHMS .250W 1.0%		
--RF06BW1620F		6	A0271778	RES FILM 162.00 OHMS .250W 1.0%		
--RF06BW2210F		42	A0266442	RES FILM 221.00 OHMS .250W 1.0%		
--RF06BW3320F		73	A0253463	RES, FILM, 332.000 OHMS .250 POWER, 1.00 TOL		
--RF49BW0000F		1	A0296948	RES FILM AX 0.0 OHM 0.25W 1.0% 100 PPM/C		
--SCT01B316		1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION		
--SCT01B320		1	A0284937	SOCKET DIP 20 POSITION,RIGID INSULATION		
-NT9X46AA		4	B0222732	NETWORK INTERFACE MODULE COMMON PACKS	32	42
--CA07X4C4R7M035T		1	A0337002	CAP AL SMD 4.7UF 20.0% 35V 105C 4.50MM SIZE		
--CHC0805X7R102K1B		7	A0605702	CAP CER CHIP 1.0NF 10.00% 100.0V X7R 0805 NICKEL		
--CHC0805X7R103J5B		5	A0322287	CAP CER CHIP 10.0NF 5.00% 50.0V X7R 0805		
--CHC0805X7R472K1B		6	A0322260	CAP CER CHIP 4.7NF 10.00% 100.0V X7R 0805		
--CHC1206X7R104J5B		6	A0382306	CAP, CER, CHIP, 100NF, 5%, 50V, X7R, 1206, NICKEL		
--CHR01A1001		23	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01B2210W		18	A0601183	RES FILM SMT 221.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B3320W		18	A0617043	RES FILM SMT 332.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR05A4701		8	A0315362	RES FILM SMT 4.70 KOHM 0.125W 5.00% 200 PPM/C		
--CRP04P37ZS2450GBL		1	A0645794	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE RT PCB FP		
--CTP22P360ZN		1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F		
--FUS45X4.0		1	A0621603	FUSE SMD FAST 4.000A 125VAC/DC 2917 SIZE		
--NT9V46AA		1	B0238536	PARALLEL PORT INTERFACE FIRMWARE	7	5
---QM28SCID04-90CH5		1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION		
---QM28SCID04-90CH503RN		1	A0635723	PROGRAMM DEVICE FOR NT9V46AA		1
---QMGAL16V8A-15LCT5		1	A0378822	PLCC20,16/8PROM,15NS,MACROCELL		
---QMGAL16V8A-15LCT503F		1	A0635722	PROGRAMMED DEVICE FOR NT9V46AA	M	1
--NT9X4601		1	P0675069	PARALLEL PORT INTERFACE PC	6	6
--P0183093		4	P0183093	LOCK WASHER		
--P0298849		4	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
--P0552373		2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR		
--P0668559		2	P0668559	4X90 MOUNTING BLOCK		
--P0668560		2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
--P0668561		2	P0668561	KEY OCTAGON FOR A0324156		
--P0668769		2	P0668769	INSERTION AID		
--P0668771		1	P0668771	SHEAR PLATE		
--P0675233		1	P0675233	FACEPLATE		
--P0676546		1	P0676546	REAR LATCH		
--P0676696		1	P0676696	REAR UPPER LATCH		
--P0703914		7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0
--P0703915		1	P0703915	DSUB BECU FINGER GASKET	2	0
--P0719254		6	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688		
--QM-DS1000Z-100H5		1	A0604952	MICROCIRCUIT, CMOS, DELAY LINE, 5-TAP, TOTAL DELAY		
--QM74ALS245H5		1	A0329224	IC ALSTTL OCTAL BUS XCVR 3S (SM)		
--QM74ALS873H5		1	A0616681	IC ALSTTL DUAL LATCH D 4-BIT		
--QM74F04H5		3	A0344794	HEX INVERTER		
--QM74F08H5		1	A0344795	MC		
--QM74F138H5		1	A0344821	MC		
--QM74F163H5		1	A0344798	MC		
--QM74F240H5		1	A0325315	IC FTTL OCTAL BUFF INV 3S (SM)		
--QM74F373H5		1	A0344820	MC		
--QM74F374H5		4	A0344990	MC		
--RNS01W16A330G		1	A0376974	RES NET SMT 33.0 OHM 0.16W 2.0% 8 RES 16 PINS		
-NT9X49CC		2	B0234509	MS P-BUS TERMINATOR CP	12	7
--A0344793		1	A0344793	IC FTTL SHIFT REG 8-BIT S-P (SM)		
--A0344797		1	A0344797	IC FTTL QUAD FF D (SM)		
--CA07X6C100M050T		1	A0337004	CAP AL SMD 10.0UF 20.0% 50V 105C 6.80MM SIZE		
--CA07X6C470M016T		1	A0337006	CAP AL SMD 47.0UF 20.0% 16V 105C 6.80MM SIZE		
--CHC1206X7R104K5B		39	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206		
--CHR01B1000		2	A0385496	RES FILM SMT 100.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B1100W		43	A0617322	RES FILM SMT 110.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B1650		35	A0642021	RES FILM SMT 165.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B2210W		56	A0601183	RES FILM SMT 221.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B3320W		56	A0617043	RES FILM SMT 332.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B82R5W		2	A0634856	RES FILM SMT 82.50 OHM 0.250W 1.00% 100 PPM/C		
--CHR05A1001		34	A0298036	RES FILM SMT 1.00 KOHM 0.125W 5.00% 200 PPM/C		
--CHR05A4701		16	A0315362	RES FILM SMT 4.70 KOHM 0.125W 5.00% 200 PPM/C		
--CTP22P360ZN		1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F		
--FUS45X5.0		1	A0378482	FUSE, FAST, SMD, 5.0A, 125VAC/DC, MOLDED, 2917 SIZ		
--NT9V49CC		1	B0234961	MS P-BUS TERMINAL CP FIRMWARE	5	2
---QM28SCID04-90CH5		1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION		
---QM28SCID04-90CH503RP		1	A0637360	PROGRAMMED DEVICE FOR NT9V49CC		1
--NT9X4904		1	P0813850	MS P-BUS TERMINATOR PCB	2	3
--P0668560		2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
--P0668561		2	P0668561	KEY OCTAGON FOR A0324156		
--P0668764		2	P0668764	FRONT LATCH		
--P0668765		2	P0668765	INSERTION AID		
--P0668766		1	P0668766	FRONT FACEPLATE		
--P0675738		1	P0675738	LOGIC CARD CENTER LABEL	2	0
--P0691815		6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI		
--P0691817		10	P0691817	GUP #4-40 HEX WASHER HEAD MACH		
--P0691821		4	P0691821	GUP #4-40 WASHER HEAD MACH		
--P0703914		7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0
--P0719254		2	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688		
--P0727020		1	P0727020	10 X 15 DIE CAST STIFFENER	5	0
--QDK76A		1	A0345543	DIODE, SCHOTTKY, 70V 15MA SMD		
--QM74ALS02H5		1	A0344994	MC		
--QM74ALS04H5		4	A0329233	IC ALSTTL HEX INV (SM)		
--QM74ALS08H5		2	A0329230	IC ALSTTL QUAD AND (SM)		
--QM74ALS109H5		2	A0353011	MC		
--QM74ALS244H5		6	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)		
--QM74ALS253H5		1	A0353019	MC		
--QM74ALS273H5		1	A0329226	IC ALSTTL OCTAL FF D (SM)		
--QM74ALS32H5		2	A0329228	IC ALSTTL QUAD OR (SM)		
--QM74ALS521H5		3	A0353106	MC		

--QM74F112H5	1	A0325316	IC FTTL DUAL FF JK (SM)		
--QM74F163H5	2	A0344798	MC		
--QM74F240H5	3	A0325315	IC FTTL OCTAL BUFF INV 3S (SM)		
--QM74F245H5	2	A0346784	MC		
--QM74F32H5	1	A0344796	MC		
--QM74F38H5	1	A0329260	IC FTTL QUAD NAND BUFF OC (SM)		
--QM74LS139H5	1	A0325344	IC LSTTL DUAL DEMUX 2 - 4 (SM)		
--QM74LS14H5	1	A0325340	IC LSTTL HEX INV SCHMITT TRIGGER (SM)		
-NT9X52AA	2	B0223991	T-BUS ACCESS CP	36	AT
--A0336600	3	A0336600	IC HCMOS 4-BIT MAGTD COMPTR (SM)		
--A0344797	2	A0344797	IC FTTL QUAD FF D (SM)		
--A0345721	1	A0345721	IC FTTL QUAD XOR (SM)		
--A0353424	3	A0353424	IC ALSTTL DUAL FF D 4-BIT (SM)		
--CA07X6C100M050T	1	A0337004	CAP AL SMD 10.0UF 20.0% 50V 105C 6.80MM SIZE		
--CA07X6C470M016T	1	A0337006	CAP AL SMD 47.0UF 20.0% 16V 105C 6.80MM SIZE		
--CHC1206C0G220J5B	4	A0368181	CAP CER CHIP 22.0PF 5.00% 50.0V C0G 1206		
--CHC1206X7R104K5B	115	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206		
--CHR01A1001	157	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1501	1	A0323939	RES FILM SMT 1.50 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A2210	51	A0312162	RES FILM SMT 221.00 OHM 0.125W 1.00% 100 PPM/C		
--CHR01A3320	51	A0319398	RES FILM SMT 332.00 OHM 0.125W 1.00% 100 PPM/C		
--CHR01A4701	1	A0382871	RES FILM SMT 4.70 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01B2000W	4	A0616427	RES FILM SMT 200.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B2210W	2	A0601183	RES FILM SMT 221.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR01B3320W	2	A0617043	RES FILM SMT 332.00 OHM 0.250W 1.00% 100 PPM/C		
--CHR06A1000	4	A0314618	RES FILM SMT 100.00 OHM 0.125W 5.00% 200 PPM/C		
--CHR11A0000	4	A0296797	RES FILM SMT 0.0 OHM (JUMPER) 2 AMP MAX		
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F		
--NT9V52AA	1	B0235692	MSP T-BUS ACCESS CIRCUIT PACK FIRMWARE	15	10
---QM27C256-12T5	1	A0352595	MEMORY IC, CMOS OTPROM, 32KX8, 120NS, PLCC32		
---QM27C256-12T503RDS	1	A0626269	PROGRAMMED DEVICE FOR NT9X52AA		1
---QM27HC291-35T5	3	A0382079	MEMORY IC, CMOS OTP ROM, 2KX8, 35NS, PLCC28		
---QM27HC291-35T503RDP	1	A0626266	PROGRAMMED DEVICE FOR NT9X52AA		1
---QM27HC291-35T503RDQ	1	A0626267	PROGRAMMED DEVICE FOR NT9X52AA		1
---QM27HC291-35T503RDR	1	A0626268	PROGRAMMED DEVICE FOR NT9X52AA		1
---QM28SCID04-90CH5	1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION		
---QM28SCID04-90CH503RN	1	A0637023	PROGRAMMED DEVICE FOR NT9V52AA		1
---QMGAL16V8A-15LCT5	1	A0378822	PLCC20,16/8PRGM,15NS,MACROCELL		
---QMGAL16V8A-15LCT503F	1	A0626270	PROGRAMMED DEVICE FOR NT9X52AA	T	2
---QMPALCE22V10H-15CT5	1	A0352108	IC EECMOS PAL 15NS (SM)		
---QMPALCE22V10H-15CT5(	1	A0626271	PROGRAMMED DEVICE FOR NT9X52AA	R	1
--NT9X5201	1	P0676156	PCB FOR NT9X52AA	6	5
--P0183093	1	P0183093	LOCK WASHER		
--P0298849	1	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156		
--P0668764	2	P0668764	FRONT LATCH		
--P0668766	1	P0668766	FRONT FACEPLATE		
--P0675738	1	P0675738	LOGIC CARD CENTER LABEL	2	0
--P0682710	2	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)		
--P0691810	1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344		
--P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI		
--P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH		
--P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH		
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0
--P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER	5	0
--QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO		
--QM-DS1000Z-100H5	1	A0604952	MICROCIRCUIT, CMOS, DELAY LINE, 5-TAP, TOTAL DELAY		
--QM6264-35T5	11	A0354308	MEMORY IC, CMOS SRAM, 8KX8, 35NS, SOJ28(300MIL)		
--QM74ALS00H5	3	A0329229	IC ALSTTL QUAD NAND (SM)		
--QM74ALS02H5	4	A0344994	MC		
--QM74ALS04H5	10	A0329233	IC ALSTTL HEX INV (SM)		
--QM74ALS08H5	2	A0329230	IC ALSTTL QUAD AND (SM)		
--QM74ALS109H5	5	A0353011	MC		
--QM74ALS138H5	3	A0329231	IC ALSTTL DEMUX 3 - 8 (SM)		
--QM74ALS14H5	1	A0376778	MICROCIRCUIT, ALSTTL, GATE		
--QM74ALS175H5	2	A0353015	MC		
--QM74ALS240H5	1	A0346627	MC		
--QM74ALS244H5	24	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)		
--QM74ALS245H5	2	A0329224	IC ALSTTL OCTAL BUS XCVR 3S (SM)		
--QM74ALS273H5	3	A0329226	IC ALSTTL OCTAL FF D (SM)		
--QM74ALS27H5	1	A0345061	IC, LOGIC, ALS, GATE		
--QM74ALS32H5	8	A0329228	IC ALSTTL QUAD OR (SM)		
--QM74ALS373H5	1	A0329221	IC ALSTTL OCTAL LATCH D 3S (SM)		
--QM74ALS374H5	18	A0329222	IC ALSTTL OCTAL FF D 3S (SM)		
--QM74ALS521H5	4	A0353106	MC		
--QM74ALS74H5	1	A0329223	IC ALSTTL DUAL FF D 3S (SM)		
--QM74F00H5	1	A0344991	LOGIC, FAST, QUAD 2-INPUT NAND GATE		
--QM74F04H5	2	A0344794	HEX INVERTER		
--QM74F08H5	1	A0344795	MC		
--QM74F109H5	1	A0337252	IC		
--QM74F10H5	1	A0337023	MC		
--QM74F112H5	1	A0325316	IC FTTL DUAL FF JK (SM)		
--QM74F14H5	1	A0353777	MC		
--QM74F163H5	1	A0344798	MC		
--QM74F20H5	1	A0345060	MC		
--QM74F240H5	5	A0325315	IC FTTL OCTAL BUFF INV 3S (SM)		
--QM74F244H5	10	A0344819	IC, FTTL, OCTAL DRIVER		
--QM74F280H5	17	A0346029	MC		
--QM74F32H5	2	A0344796	MC		
--QM74F374H5	9	A0344990	MC		
--QM74F377H5	4	A0367125	IC FTTL OCTAL FF D (SM)		
--QM74F38H5	3	A0329260	IC FTTL QUAD NAND BUFF OC (SM)		
--QM74F64H5	1	A0344992	IC, FTTL, GATE		
--QM74HCT08H5	1	A0355382	MC		
--QM74HCT32H5	1	A0368310	IC HCMOS QUAD OR (SM)		
--QM74HCT393H5	1	A0368278	IC HCMOS DUAL BIN COUNTER (SM)		
--QM80C31T5	1	A0329243	IC CMOS UP 8-BIT ROMLESS (SM)		
--QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)		
--QMV165-1FF5	1	A0619973	BUS ACCESS CIRCUIT,N04, FREE LEAD VERSION, PQFP128		
--QNM1100PST4	1	A0377090	CRYSTAL OSC, TRISTATE, PLASTIC, ,SMD		
--QT-MMPQ2907	1	A0616059	XSTR PNP ARRAY 40V 0.6A SURFACE		
-NT9X54AC	2	B0228538	STRATUM 1 EXTERNAL CLOCK INTERFACE CP	14	19
--A0252936	1	A0252936	DIODE SWITCH .2A 75V		
--A0253336	2	A0253336	RES FILM 10 KOHM 1/4W 1%		
--CA14X100M035S	1	A0286651	CAP AL AX 10.0UF 20.000% 35.0V 85C		
--CA14X150M025S	2	A0279453	CAP AL AX 15.0UF 20.000% 25.0V 85C		
--CA14X1R0M050S	4	A0286445	CAP AL AX 1.0UF 20.000% 50.0V 85C		
--CA14X470M010S	2	A0291583	CAP AL AX 47.0UF 20.000% 10.0V 85C		
--CB17Z5UC104Z	23	A0314520	CAP CER AX 0.1UF 50V +80-20%		
--CB19C0GA121J	2	A0261790	CAP CER AX 120PF 50V 5%		
--CB19C0GA150K	1	A0257267	CAP CER AX 15PF 50V 10%		
--CB19C0GA330J	2	A0258760	CAP CER AX 33PF 50V 5%		
--CB19C0GA471J	2	A0248721	CAP CER AX 470PF 50V 5%		
--CB19C0GA4R7D	1	A0254057	CAP CER AX 4.7PF 50V 0.5PF		
--CB19C0GA680J	1	A0261728	CAP CER AX 68PF 50V 5%		
--CB19C0GA6R8D	1	A0257239	CAP CER AX 6.8PF 50V 0.5PF		
--CRF02BR56K	2	A0256946	INDUCTOR 0.56UH 495MA .21W 10%		
--CRP04P09ZS2450G	1	A0362039	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE RT PCB FP		
--CRP04P37ZS2450G	1	A0362040	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE RT PCB FP		
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F		

-CXD12JL1510	2	A0360961	CONN COAX QLA STRAIGHT BULKHEAD JACK SOLDER CUP		
-NR12Q16B1001G	1	A0255715	RES, NETWORK, 1000.000 OHMS .100 POWER, 2.00 TOL		
-NT9V54AC	1	B0230185	STRATUM 1 EXTENSION CLOCK INTERFACE	2	1
--QM6331L-55P503FFB	1	A0348919	MICROCIRCUIT		1
-NT9X5404	1	P0702208	MS EXT. CLOCK INTERFACE PCB (JAPAN CCS)	1	1
-P0038869	5	P0038869	PAN HD SLT MACH SCREW, 086-56 X 0.312, STEEL, 289A		
-P0183093	9	P0183093	LOCK WASHER		
-P0183134	4	P0183134	LOCK WASHER LOCK WASHER		
-P0298849	9	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
-P0552373	2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR		
-P0668559	2	P0668559	4X90 MOUNTING BLOCK		
-P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
-P0668561	2	P0668561	KEY OCTAGON FOR A0324156		
-P0668769	2	P0668769	INSERTION AID		
-P0668771	1	P0668771	SHEAR PLATE		
-P0676546	1	P0676546	REAR LATCH		
-P0676696	1	P0676696	REAR UPPER LATCH		
-P0682710	6	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)		
-P0702418	1	P0702418	REAR FACEPLATE		
-P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0
-P0703915	2	P0703915	DSUB BECU FINGER GASKET	2	0
-QB-PG504	1	A0314399	PWR CONV PCB MOUNT DCDC 1W		
-QD-1N5225B	2	A0272341	DIODE ZENER <1W 3V		
-QD-1N5228B	2	A0273226	DIODE ZENER <1W 3.9V		
-QDK40A	2	A0285506	DIODE HIGH SPEED SCHOTTKY		
-QFF4A7	2	A0259507	FUSE, FAST, AX, 5A, 125V, PICO		
-QM-LH0032CM	1	A0797429	MICROCIRCUIT, LINEAR, ULTRA FAST FET-INPUT OPERATI		
-QM26LS32P5	4	A0263745	IC INTRF RECEIVER		
-QM319P5	3	A0263691	IC LINEAR DUAL COMPRTR		
-QM3487P5	1	A0264670	IC INTFC QUAD DRVR EIA		
-QM74ALS00P5	2	A0291651	IC ALSTTL QUAD NAND		
-QM74ALS04P5	1	A0292332	IC ALSTTL HEX INV		
-QM74ALS109P5	1	A0292264	IC ALSTTL DUAL FF JK		
-QM74ALS244P5	2	A0292052	IC ALSTTL OCTAL BUFF 3S		
-QM74ALS273P5	1	A0311969	IC ALSTTL OCTAL FF D		
-QM74ALS32P5	1	A0291654	IC ALSTTL QUAD OR		
-QM74ALS74P5	1	A0292336	IC ALSTTL DUAL FF D		
-QM74F38P5	1	A0316946	IC FTTL QUAD NAND BUFF OC		
-QMDG180CD1	1	A0310018	IC LINEAR ANALOG SWITCH DUAL		
-QMTL7702AE5	1	A0327091	MICROCIRCUIT, LINEAR SUPPLY VOLTAGE SUPERVISOR		
-QT-PN2907A	1	A0272995	TRANSISTOR PNP SMALL SIGNAL 60VCE 0.6A		
-QTK109B46	1	A0277852	XFORMER CONVERTER		
-QTK263A4	2	A0313997	XFORMER PULSE		
-R0105446	1	R0105446	HOOK-UP WIRE, SINGLE 30AWG STRAND= 1X30AWG INSUL=		
-RF06BW1001F	16	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW1003F	2	A0253438	RES, FILM, 100000.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW1100F	1	A0244608	RES, FILM, 110.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW1301F	1	A0255546	RES, FILM, 1300.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW1500F	1	A0271764	RES FILM 150.00 OHMS .250W 1.0%		
-RF06BW1501F	1	A0255782	RES, FILM, 1500.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW2001F	2	A0270346	RES FILM 2000.00 OHMS .250W 1.0%		
-RF06BW2002F	2	A0255548	RES, FILM, 20000.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW2210F	4	A0266442	RES FILM 221.00 OHMS .250W 1.0%		
-RF06BW2372F	2	A0255549	RES, FILM, 23700.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW3011F	2	A0253460	RES, FILM, 3010.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW3571F	1	A0263018	RES FILM 3570.00 OHMS .250W 1.0%		
-RF06BW3921F	2	A0255793	RES, FILM, 3920.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW4750F	1	A0271963	RES FILM 475.00 OHMS .250W 1.0%		
-RF06BW5110F	4	A0263182	RES FILM 511.00 OHMS .250W 1.0%		
-RF06BW5112F	2	A0253436	RES, FILM, 51100.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW51R1F	1	A0271978	RES FILM 51.100 OHMS .250W 1.0%		
-RF06BW5620F	1	A0272000	RES FILM 562.00 OHMS .250W 1.0%		
-RF06BW75R0F	1	A0272035	RES FILM 75.00 OHMS .250W 1.0%		
-RF49BW0000F	4	A0296946	RES FILM AX 0.0 OHM 0.25W 1.0% 100 PPM/C		
-RSP06H2C05S1	1	A0329638	RELAY FS 2 FORM C 5V		
-SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION		
-NT9X62AA	2	B0228257	DS-64 2 PORT PADDLEBOARD CP	27	21
-A0344797	2	A0344797	IC FTTL QUAD FF D (SM)		
-A0345721	1	A0345721	IC FTTL QUAD XOR (SM)		
-A0352299	1	A0352299	IC CUSTOM QFLIC SUDS (120PGA)		
-CA07X6C470M016T	2	A0337006	CAP AL SMD 47.0UF 20.0% 16V 105C 6.60MM SIZE		
-CHC1206C0G330J5B	3	A0336637	CAP CER CHIP 33.0PF 5.00% 50.0V C0G 1206		
-CHC1206X7R102K5B	4	A0344870	CAP CER CHIP 1.0NF 10.00% 50.0V X7R 1206		
-CHC1206X7R103K5B	1	A0319234	CAP CER CHIP 10.0NF 10.00% 50.0V X7R 1206 NICKEL		
-CHC1206X7R104K5B	69	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206		
-CHC1206X7R473J5B	2	A0329043	CAP CER CHIP 47.0NF 5.00% 50.0V X7R 1206		
-CHR01A1001	12	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A1002	25	A0293769	RES FILM SMT 10.00 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A20R0	15	A0325355	RES FILM SMT 20.00 OHM 0.125W 1.00% 100 PPM/C		
-CHR01A3162	1	A0316644	RES FILM SMT 31.60 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A4750	24	A0312158	RES FILM SMT 475.00 OHM 0.125W 1.00% 100 PPM/C		
-CHR01A4751	3	A0315266	RES FILM SMT 4.75 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A4752	1	A0326635	RES FILM SMT 47.50 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A51R1	8	A0321168	RES FILM SMT 51.10 OHM 0.125W 1.00% 100 PPM/C		
-CHR01A7500	6	A0321170	RES FILM SMT 750.00 OHM 0.125W 1.00% 100 PPM/C		
-CHR01A7501	1	A0315277	RES FILM SMT 7.50 KOHM 0.125W 1.00% 100 PPM/C		
-CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F		
-CTS10Y2312T100K10	2	A0328922	CAP TAN CHIP 10UF 10V 10% (SM)		
-FUS45X2	1	A0376205	FUSE, FAST, SMD, 2.0A, 125VAC/DC, MOLDED, 2917 SIZ		
-FUS45X5.0	1	A0378482	FUSE, FAST, SMD, 5.0A, 125VAC/DC, MOLDED, 2917 SIZ		
-NT9V62AA	1	B0230314	2-PORT SUB-RATE DS512 P.B. FIRMWARE	5	3
--QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16		
--QM6331L-55P5GFY	1	A0363217	MICROCIRCUIT		1
--QM87C51T5	1	A0345690	MC, 0 TO 70 C, PLCC44		
--QM87C51T503GGC	1	A0363220	MICROCIRCUIT		2
-P0183093	5	P0183093	LOCK WASHER		
-P0298849	5	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
-P0552373	2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR		
-P0668559	2	P0668559	4X90 MOUNTING BLOCK		
-P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
-P0668561	2	P0668561	KEY OCTAGON FOR A0324156		
-P0668769	2	P0668769	INSERTION AID		
-P0676546	1	P0676546	REAR LATCH		
-P0676696	1	P0676696	REAR UPPER LATCH		
-P0691810	1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344		
-P0697680	1	P0697680	DS-64 2 PORT PADDLEBOARD PCB	2	3
-P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0
-P0714967	1	P0714967	HSI SHEAR PLATE	2	1
-P0719254	6	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688		
-P0727345	1	P0727345	REAR FACEPLATE (4-FBR)	1	0
-QD-LP4002	2	A0328500	DIODE RECTIFIER MELF (SMD)		
-QFR01B	2	A0679569	**1300 NM RECEIVER, 50 MBS, MULTI MODE, ST CONNECT		
-QFT01A	2	A0368186	**1300 NM MM TRANSMITTER, 49.152 MBPS, 14 PIN PLAS		
-QHP200A26	2	A0293604	INDR POWER INDUCTOR THRU-HOLE 96.000 UH		
-QM10135P5	1	A0292123	IC ECL DUAL FF J-K		
-QM10H124P5	1	A0351410	MICROCIRCUIT, ECL, DRIVER		
-QM10H125P5	2	A0351411	MICROCIRCUIT, ECL, DRIVER		
-QM25DL-1P5	1	A0352156	5 TAP DELAY LINE		
-QM358H5	2	A0298039	IC LINEAR DUAL OP-AMP		
-QM431H5	1	A0324170	IC LINEAR VOL REGLTR (SM)		
-QM74ALS04H5	2	A0329233	IC ALSTTL HEX INV (SM)		

--QM74ALS05H5	1	A0353881	MC			
--QM74ALS08H5	1	A0329230	IC ALSTTL QUAD AND (SM)			
--QM74ALS244H5	1	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)			
--QM74ALS74H5	1	A0329223	IC ALSTTL DUAL FF D 3S (SM)			
--QM74F00H5	2	A0344991	LOGIC, FAST, QUAD 2-INPUT NAND GATE			
--QM74F04H5	2	A0344794	HEX INVERTER			
--QM74F08H5	1	A0344795	MC			
--QM74F109H5	1	A0337252	IC			
--QM74F112H5	1	A0325316	IC FTTL DUAL FF JK (SM)			
--QM74F125H5	2	A0345720	MC			
--QM74F32H5	1	A0344796	MC			
--QM74F543H5	1	A0329256	IC FTTL OCTAL BUS XCVR 3S (SM)			
--QM74F74H5	1	A0322324	IC FTTL DUAL FF D (SM)			
--QMAD7545GP5	1	A0337296	IC			
--QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)			
--QMV288CY1	2	A0377239	TRANSMIT/RECEIVE CHIP			
--QMV440AL5	1	A0370246	IC STAND CELL ASIC SUB-RATE CONT (PLASTIC 120 PGA)			
--QNM1523A16	1	A0355021	OSC			
--QNM57K1	1	A0353734	OSC VCXO 49.152MHZ 30.000PPM			
--RNS01W16B103G	3	A0345073	RES NET SMT 10.0 KOHM 0.06W 2.0% 15 RES 16 PINS			
--SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION			
--SCT09B44	1	A0329648	SOCKET PLCC 44 POSITION,RIGID INSULATION			
--SIC13A121Q1	1	A0328590	SOCKET PGA 121 POSITION,REMOVABLE INSULATION			
--SIC13A85Q1	2	A0328588	SOCKET PGA 85 POSITION,REMOVABLE INSULATION			
--SIC13B121Q1	1	A0360630	SOCKET PGA 121 POSITION,REMOVABLE INSULATION			
-NT9X62CA	2	B0231169	SR512 4 LINK PB	18		11
--A0336785	1	A0336785	IC HCMOS DEMUX 3-TO-8 (SM)			
--A0336788	1	A0336788	IC HCMOS DUAL FF D (SM)			
--A0344980	1	A0344980	IC HCMOS SHIFT REG 8-BIT S-P (SM)			
--A0344988	1	A0344988	IC HCMOS COUNTER 4-BIT BIN (SM)			
--A0352299	1	A0352299	IC CUSTOM QFLIC SUDS (120PGA)			
--CA07X4C100M016T	3	A0344856	CAP, ALUM, SMD, 10UF, 20%, 16V, 105C			
--CHC1206C0G100J5B	2	A0369968	CAP CER CHIP 10.0PF 5.00% 50.0V C0G 1206			
--CHC1206X7R102K5B	11	A0344870	CAP CER CHIP 1.0NF 10.00% 50.0V X7R 1206			
--CHC1206X7R104K5B	71	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206			
--CHR01A1001	1	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1002	1	A0293769	RES FILM SMT 10.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1500	4	A0326936	RES FILM SMT 150.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A1502	1	A0291517	RES FILM SMT 15.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A4750	37	A0312158	RES FILM SMT 475.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A4751	46	A0315266	RES FILM SMT 4.75 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A51R1	18	A0321168	RES FILM SMT 51.10 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A7501	1	A0315277	RES FILM SMT 7.50 KOHM 0.125W 1.00% 100 PPM/C			
--CHR05A2201	3	A0291527	RES FILM SMT 2.20 KOHM 0.125W 5.00% 200 PPM/C			
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F			
--NR13Q16J331471G	2	A0293019	RES NETWORK 330.00 OHMS .125W 2.0%			
--NT5L78CC	1	A0326966	HYBRID FIBER CLK RCVY	2	W2	
--NT9V62CA	1	B0234547	SR512 4 LINK PB WITH 2 00B RESETS F/W	2		2
---QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16			
---TT03JFY	1	A0393403	PROGRAMMED DEVICE			1
--NT9X6204	1	P0729426	SR512 4 LINK PB WITH 2 OOB RESET PCB	3		2
--NTH446AA	1	A0362544	INDUCTOR OUTPUT RM-4 CORE			
--P0183093	5	P0183093	LOCK WASHER			
--P0298849	5	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56			
--P0552373	2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR			
--P0668559	2	P0668559	4X90 MOUNTING BLOCK			
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI			
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156			
--P0668769	2	P0668769	INSERTION AID			
--P0676546	1	P0676546	REAR LATCH			
--P0676696	1	P0676696	REAR UPPER LATCH			
--P0691810	1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344			
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2		0
--P0714987	1	P0714987	HSI SHEAR PLATE	2		1
--P0719254	6	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688			
--P0727345	1	P0727345	REAR FACEPLATE (4-FBR)	1		0
--QD-1N4002	2	A0253306	DIODE RECTIFIER 100V 1A			
--QFF4A3	1	A0259503	FUSE, FAST, AX, 1.5A, 125V, PICO			
--QFF4A5	1	A0259505	FUSE, FAST, AX, 3A, 125V, PICO			
--QFR01B	2	A0679569	**1300 NM RECEIVER, 50 MBS, MULTI MODE, ST CONNECT			
--QFT01A	2	A0368188	**1300 NM MM TRANSMITTER, 49.152 MBPS, 14 PIN PLAS			
--QHP200A26	1	A0293604	INDR POWER INDUCTOR THRU-HOLE 96.000 UH			
--QM10H124P5	2	A0351410	MICROCIRCUIT, ECL, DRIVER			
--QM10H125P5	2	A0351411	MICROCIRCUIT, ECL, DRIVER			
--QM10H131T5	1	A0322699	IC ECL DUAL D FLIP-FLOP (SM)			
--QM25DL-1P5	1	A0352156	5 TAP DELAY LINE			
--QM74ALS04H5	2	A0329233	IC ALSTTL HEX INV (SM)			
--QM74ALS08H5	3	A0329230	IC ALSTTL QUAD AND (SM)			
--QM74ALS164H5	1	A0351465	MICROCIRCUIT, ADVANCED LOW POWER SCHOTTKY, STATIC			
--QM74ALS244H5	3	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)			
--QM74ALS245H5	1	A0329224	IC ALSTTL OCTAL BUS XCVR 3S (SM)			
--QM74ALS38H5	1	A0329527	MC			
--QM74F04H5	1	A0344794	HEX INVERTER			
--QM74F244H5	2	A0344819	IC, FTTL, OCTAL DRIVER			
--QM74F374H5	1	A0344990	MC			
--QM74F579H5	1	A0367122	IC FTTL 8-BIT BINARY COUNTER (SM)			
--QM74HC166H5	1	A0324108	IC HCMOS SHIFT REG 8-BIT S/P-S (SM)			
--QM74HCT32H5	1	A0368310	IC HCMOS QUAD OR (SM)			
--QM74HCT374H5	2	A0329092	IC HCMOS OCTAL FF D 3S (SM)			
--QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)			
--QMV288CY1	2	A0377239	TRANSMIT/RECEIVE CHIP			
--QMV440AL5	1	A0370246	IC STAND CELL ASIC SUB-RATE CONT (PLASTIC 120 PGA)			
--SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION			
--SIC13A121Q1	1	A0328590	SOCKET PGA 121 POSITION,REMOVABLE INSULATION			
--SIC13A85Q1	2	A0328588	SOCKET PGA 85 POSITION,REMOVABLE INSULATION			
--SIC13B121Q1	1	A0360630	SOCKET PGA 121 POSITION,REMOVABLE INSULATION			
-NT9X6534	2	B0229784	BULKHEAD ASSEMBLY (LEFT)	3		2
--CRP14M050	4	A0317136	CONN ACCESSORY D SUB, 4-40 SCREWLOCK			
--FCP01C09N50G	1	A0336796	CONN FILTER D SUB, 375 PF ADAPTER			
--NT9X6543	1	B0231573	BULKHEAD PLATE ASSEMBLY	2		2
---CRP14M004	16	A0279319	D SUB MALE SCREW RETAINER KIT			
---P0703715	1	P0703715	BULKHEAD PLATE	2		0
--P0701815	4	P0701815	0.825 X 0.5 OBLONG GROMMET	2	D1	
-NT9X7204	1	B0230032	36 LIU LINK INTERFACE SHELF ASSEMBLY	27		5
--NPS25028L35	1	A0292488	CONN SHORTING LINK 1X2 ARRAY 0.100 PITCH AU FEMALE			
--NPS50394-03L2	2	A0326749	BUS BAR			
--NT9X0406	1	B0223461	CONN BACKPLANE CABLE ASSY	7		6
---CRC06M002	32	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU			
---CRC07HC20N00	2	A0322604	CONN STR HOUSING 2X10 ARRAY 0.100 PITCH NONE FEMAL			
---R0105561	0.25	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA			
---R0107948	4.877	R0107948	HOOK-UP WIRE, SINGLE, UL 1429, CSA AWMXLPVC, 24AWG			
--NT9X0408	1	B0223787	CABLE ASSY	7		6
---CRC06M002	32	A0279343	CONN CONTACT CRIMP TERMINAL 22-26 AU			
---CRC07HC20N00	2	A0322604	CONN STR HOUSING 2X10 ARRAY 0.100 PITCH NONE FEMAL			
---R0105561	0.25	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA			
---R0107948	4.064	R0107948	HOOK-UP WIRE, SINGLE, UL 1429, CSA AWMXLPVC, 24AWG			
--NT9X0490	1	B0238936	E-CORE COMMON SHELF HAREWARE KIT	1		1
---P0668728	1	P0668728	LOWER CARD GUIDE	3		0
---P0668734	1	P0668734	UPPER PERSONALITY CARD GUIDE	4		0
---P0668735	1	P0668735	LOWER PERSONALITY CARD GUIDE	3		0
---P0668736	1	P0668736	FRONT UPPER EXTRUSION	1		0

--P0668737	1	P0668737	FRONT LOWER EXTRUSION		1	0
--P0668738	1	P0668738	REAR UPPER EXTRUSION		1	0
--P0668739	1	P0668739	REAR LOWER EXTRUSION		1	0
--P0668740	1	P0668740	REAR UPPER CARD GUIDE SCREEN		1	0
--P0668741	1	P0668741	REAR LOWER CARD GUIDE SCREEN		1	0
--P0669233	2	P0669233	SHELF REINFORCING ROD		1	0
--P0706864	2	P0706864	BACKPANEL BRACKET		4	0
--P0710461	1	P0710461	UPPER CARD GUIDE		6	0
--P0729861	2	P0729861	SHELF MOUNTING BRACKET		4	0
--P0729862	1	P0729862	LEFT SIDE PANEL		3	0
--P0729863	1	P0729863	RIGHT SIDE PANEL		3	0
--P0729871	2	P0729871	SHELF MOUNTING BRACKET		1	0
--P0744405	2	P0744405	END PLATE		1	0
--P0744408	2	P0744408	COVER PLATE		1	0
--P0744410	1	P0744410	LEFT SIDE CENTER SUPPORT		1	0
--P0744411	1	P0744411	RIGHT SIDE CENTER SUPPORT		3	0
-NT9X2824	2	B0236937	POWER CONVERTER BACKPANEL ASSEMBLY		1	1
--CBR30B020S	2	A0299030	CONN TOP ENTRY 2X10 ARRAY 0.100 PITCH AU FEMALE ST			
--CFC22C16A06	1	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR			
--CTP20B48VNS6	2	A0319277	CONN STR RECEPT, P. DIN 3X16 ARRAY 0.200 PITCH AU			
--CTP20B64VNS9	2	A0326973	CONN STR RECEPT, P. DIN 4X16 ARRAY 0.200 PITCH AU			
--NT9X2827	1	P0742781	POWER CONVERTER BACKPLANE PCB (NT9X2827)		1	1
--P0142036	3	P0142036	SCREW,PAN HEAD(MACH),SLOTTED, 0.138-32 X 0.625			
--P0180686	8	P0180686	MACHINE SCREW MACH SCR S PAN HEAD SLOTTED 0.086-56			
--P0182942	8	P0182942	LOCK WASHER			
--P0183093	8	P0183093	LOCK WASHER			
--P0298849	8	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56			
--P0594346	3	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A			
--P0639584	4	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010			
--P0675200	2	P0675200	POST KEY			
--P0675201	1	P0675201	POST TURRET			
--P0675202	2	P0675202	KEYING POST			
--P0675203	1	P0675203	CONNECTOR SHROUD			
--P0675204	4	P0675204	CONNECTOR POST			
--P099D274	2	P099D274	TAPPING SCREW TAPPING SCR S B PAN HEA			
-NT9X6107	2	B0238940	INTERFACE PANEL ASSEMBLY		2	2
--CRP04W09V651	1	A0606797	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP			
--CRP14M002	1	A0279333	D SUB FEMALE SCREW LOCK			
--FTB1X3A	1	A0605068	FILTERED TERMINAL BLOCK			
--NT0X2706	1	B0238938	INTERFACE PANEL MECH. ASSEMBLY		1	1
--P0639615	2	P0639615	STANDOFF SELF-CLINCH, INT THD, (PENN ENG. SOS-440-			
--P0661462	2	P0661462	STANDOFF SELF-CLINCH, BLIND, 0.112-40, SS			
--P0744409	1	P0744409	INTERFACE PLATE		2	0
--NT1X6111	1	B0239829	POWER INTERFACE CP		1	1
--CB18X7RA331K	9	A0274436	CAP CER AX 330PF 100V 10%			
--CRP04L09PN	1	A0291697	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE STR WWRAP			
--CTP27P020VN	1	A0604987	CONN STR HEADER 2X10 ARRAY 0.100 PITCH AUPD M-M AD			
--NT9X6108	1	P0742783	POWER INTERFACE PCB (NT9X6108)		1	2
--P099D465	2	P099D465	SCREW, TYPE B PAN HD SLT, 0.112-24X0.188, STEEL, 2			
--SPC13C9W3LD	2	A0604955	SW TOGGLE 2PDT (ON)-ON-(ON) W WRAP TERM			
--P0180927	2	P0180927	PHM SCREW 0.112-40 X 0.500 X 0.219			
--P0242824	2	P0242824	PHM SCR .112X40X1.375			
--P0249752	2	P0249752	LOCK WASHER			
--P0594316	2	P0594316	KEPS, PREASSEMBLED, HEX NUT & EXT LOCKWASHER .112			
--P0594346	2	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A			
--QD-HP4655	2	A0270192	DIODE LED RED			
--R0114610	2	R0114610	EMI/RFI BERYLLIUM COPPER SLOTTED SHIELDING,SELF-AD			
--SPC13C9W3LD	2	A0604955	SW TOGGLE 2PDT (ON)-ON-(ON) W WRAP TERM			
-NT9X7205	1	B0230033	36 LIU BACKPANEL ASSEMBLY		3	2
--CFC22C16A06	2	A0336047	CONN STR HEADER 2X8 ARRAY 0.100 PITCH AU MALE STR			
--CTP21H360C	26	A0344714	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA			
--CTP21H360CNR1	26	A0325203	CONN NORCON, SHROUD 4X90 ARRAY 0.100 PITCH NONE MA			
--NPS25230L1D	8216	A0344712	PCB PIN COMPLIANT (REPLACED BY A0354273 FOR .100 P			
--NPS25230L2D	1144	A0344713	PCB PIN COMPLIANT			
--NPS25230L49D	4	A0369195	PCB PIN COMPLIANT			
--NT9X7206	1	P0704614	36 LIU BACKPANEL PCB		2	2
--P0183093	26	P0183093	LOCK WASHER			
--P0251628	4	P0251628	TAPPING SCREW TAPPING SCR S F PAN HEAD (SLTD) 0.11			
--P0639584	11	P0639584	PIN,MACHINE,SPIRAL SPRING,0.125 X 0.375 X 0.010			
--P0669306	52	P0669306	SOCKET HEAD CAP SCREW			
--P0669307	26	P0669307	4X90 CONNECTOR GUIDE PIN			
--P0669314	26	P0669314	4X90 CONNECTOR SOCKET GUIDE PIN			
--P0669316	52	P0669316	POLARIZING KEY THREADED		1	0
--P0669317	52	P0669317	4X90 CONNECTOR POLAR KEY-UNTHREAD		2	0
--P0138380	4	P0138380	MACHINE SCREW MACHINE S			
--P0242132	36	P0242132	WASHER, SPRING HELICAL .168 X 0.296 X 0.040			
--P0284145	32	P0284145	WASHER			
--P0559409	130	P0559409	THREADED FORMING SCREW, HEX WSHR HD TYPE TT, 0.138			
--P0594346	48	P0594346	BELLEVILLE WASHER, MAT: SS, FIN: 662A			
--P0627369	6	P0627369	HEX NUT & WASHER ASSY (KEPS)			
--P0631766	10	P0631766	RIVET, MATL CODE= S 289A FINISH, DIA= 0.125 0.425			
--P0633700	18	P0633700	CABLE TIE, LOCKING. MAX BUNDLE DIAMETER: 0.87", LE			
--P0633746	4	P0633746	CABLE TIE MOUNTING BASE, SCREW MOUNT FOUR WAY, MAT			
--P0668725	2	P0668725	CARD GUIDE EMI SCREEN		2	0
--P0676101	48	P0676101	LOCK WASHER, EXT TOOTH, PHOSPHOR BRONZE FIN: 562A,			
--P0678310	2	P0678310	SEE P0633725 AS POSSIBLE SUBSTITUTE			
--P0706928	4	P0706928	SHELF GASKET		2	0
--P0739094	1	P0739094	SHELF STRIP LS (FRONT)		4	0
--P097G010	96	P097G010	TAPTITE TAP SCREW			
--P097Y561	16	P097Y561	TOPTITE TAPPING SCREW			
--P099Q697	48	P099Q697	6-32 HEX NUT			
--R0109727	4	R0109727	EMI GASKET MATL,RUBBER,DIA4.78MM(0.188")MONEL OVER			
-NTEX5026	1	B0234545	MS0 TO MS1 CABLE ASSEMBLY		1	1
--CRP03G25T50G	2	A0361663	CONN D SUB D ARRAY 0.109 PITCH AU MALE IDT 2426			
--CRP14M061	2	A0323869	CONN HOOD D SUB D-25 ARRAY			
--P0633700	2	P0633700	CABLE TIE, LOCKING. MAX BUNDLE DIAMETER: 0.87", LE			
--R0102591	0	R0102591	SWBD CBL 26AWG 1X26 TIN CU 18 PAIR NO SHLD PVC			
-P0709179	1	P0709179	DESIGN STRIP REAR NT9X72BA			
-P0725905	2	P0725905	DESIGNATION LABEL (NT9X12AD)		2	0
-P0735786	1	P0735786	ENI DESIGN STRIP (REAR)		1	0
-P0739094	1	P0739094	SHELF STRIP LS (FRONT)		4	0
-P0739095	1	P0739095	SHELF STRIP LS (REAR BOT)		3	0
-P0739096	1	P0739096	SHELF STRIP LS (REAR TOP)		3	0
-P0739097	1	P0739097	DESIGN STRIP LS (FRONT)		3	0
-P0739100	1	P0739100	SHELF STRIP ENI (REAR)		3	0
-P0739101	1	P0739101	SHELF STRIP ENI (REAR TOP)		3	0
-P0739102	1	P0739102	DESIGN STRIP ENI (FRONT)		3	0
NT9X9532	1	B0233903	FILTERED POWER KIT	SCC 00		
B0233726	16	NT9X9520	Shelf Power (Standalone)			
			Cable Assembly			
B0206737	1	NT0X9501	CABLE BRAID ASSEMBLY			
B0233734	2	NT9X9528	FSP Power (Standalone)			
			Cable Assembly			
B0233729	1	NT9X9523	Cooling Unit Power			
			(Standalone) Cable			
			Assembly			
B0232819	1	NT0X9591	CABLE ASSEMBLY (FGE -			

			SUPERNODE)																
B0232620	1	NT0X9592	CABLE ASSEMBLY (LRE -																
			SUPERNODE)																
A0685102	23	NPS52034L29	A0326932 EMI FEED THROUGH																
			FILTER ASSEMBLED WITH MO																
P0678343	46		BELLEVILLE WASHER, MAT:																
			SS, FIN: 662A																
P0125616	2		CAP SCREW																
			CAP SCREW																
P097Y579	1	P097Y579	EXT TOOTH LOCKWASHER																
B0234548	1	NT9X9545	FILTER CAPACITORS COVER																
			KIT																
P0160739	6	P0160739	WASHER FLAT .258ID, .562OD,																
			.063THK SPECIAL DIA																
P0183028	4	P0183028	SPRING WASHER HELICAL MED																
			.255ID, .493OD,.063THK																
P0069242	2	P0069242	CAP SCREW																
P0736059	1	P0736059	APC CABINET POWER FILTER																
			LABELS																
P0065747	2	P0065747	HEX NUT																
NT9X0324	1	B0235951	ESP GROUND TERMINATOR ASSY	SCC 00															
P0735227	2	P0735227	ESD BONDING LABEL																
P0726544	2	P0726544	ESD BONDING STUD																
P0612838	2	NPS50580-2	MACH SCREW SCR THD FMG S PAN HD																
P097Y579	2	HDBK153	EXT TOOTH LOCKWASHER																
P0714698	2	P0714698	EMI CONTACT STRIP UPRIGHT	SCC 00															
P0736058	1	P0736058	APC TERMINAL BLOCK DESIGN	SCC 00															
P0736059	1	P0736059	APC CABINET POWER FILTER	SCC 00															
P0736273	1	P0736273	OPTICAL FIBER DANGER LABEL	SCC 00															
NT9X9569	1	B0238528	C42 DOOR KIT (GREY)	SCC 00															
NT9X9569		B0238528	C42 DOOR KIT (GRAY)																
-NT9X9562	2	B0238497	DOOR ASSEMBLY LH (GRAY)																
--NPS50055-12L13	1	A0326703	CONN TERMINAL LUG DISCONNECT BENT TAB TAB																
--NT9X9566	1	B0238500	DOOR PANEL ASSEMBLY LH (GRAY)																
---P0741650	3	P0741650	STIFFENER																
---P0741684	1	P0741684	SUPPORT																
---P0742724	1	P0742724	DOOR PANEL LH																
--P0218566	2	P0218566	SPRING WASHER																
--P0559409	1	P0559409	THREADED FORMING SCREW, HEX WSHR HD TYPE TT, 0.138																
--P0640496	1	P0640496	RETAINING RING-EXTERNAL																
--P0661477	45	P0661477	BLIND RIVET FOR REPETITION																
--P0672761	1	P0672761	COMPRESSION SPRING MUSIC																
--P0719343	2	P0719343	PAN HD CR1A 0.164-32X0.375 , STEEL, 289A FINISH																
--P0719367	2	P0719367	PAN HD CR1A,0.250-20X0.500 , STEEL, 289A FINISH																
--P0719423	1	P0719423	COTTER PIN, EXTENDED PRONG, 0.125 DIA, 1.500" LG.																
--P0731164	1	P0731164	DOOR RESTRAINT STRAP																
--P0738885	1	P0738885	DOOR LATCH (GRAY)																
--P0738889	1	P0738889	BRACKET																
--P0738890	1	P0738890	TOP HINGE PIN																
--P0738891	1	P0738891	LATCH ROD																
--P0738892	2	P0738892	LATCH,TOP																
--P0738893	1	P0738893	TORSION SPRING																
--P0740830	1	P0740830	TORSION SPRING LH MODULE																
--P0742720	1	P0742720	INSIDE DOOR PANEL LH																
--P0745365	1	P0745365	EMI GASKET, VERTICAL																
--P0745366	1	P0745366	EMI GASKET, CENTER																
--P0745367	2	P0745367	EMI GASKET, HORIZONTAL (C42)																
-NT9X9563	2	B0238496	DOOR ASSEMBLY RH (GRAY)																
--NPS50055-12L13	1	A0326703	CONN TERMINAL LUG DISCONNECT BENT TAB TAB																
--NPS50415-07L01	1	A0386283	CABINET DOOR KEY LOCK, KEYED ALIKE, 13.6MM DOOR TH																
--NT9X9567	1	B0238494	DOOR PANEL ASSEMBLY RH (GRAY)																
---P0741650	3	P0741650	STIFFENER																
---P0741684	1	P0741684	SUPPORT																
---P0742721	1	P0742721	DOOR PANEL RH																
--P0218566	2	P0218566	SPRING WASHER																
--P0559409	1	P0559409	THREADED FORMING SCREW, HEX WSHR HD TYPE TT, 0.138																
--P0640496	1	P0640496	RETAINING RING-EXTERNAL																
--P0661477	43	P0661477	BLIND RIVET FOR REPETITION																
--P0672761	1	P0672761	COMPRESSION SPRING MUSIC																
--P0719343	2	P0719343	PAN HD CR1A 0.164-32X0.375 , STEEL, 289A FINISH																
--P0719367	2	P0719367	PAN HD CR1A,0.250-20X0.500 , STEEL, 289A FINISH																
--P0719423	1	P0719423	COTTER PIN, EXTENDED PRONG, 0.125 DIA, 1.500" LG.																
--P0731164	1	P0731164	DOOR RESTRAINT STRAP																
--P0738890	1	P0738890	TOP HINGE PIN																
--P0738891	1	P0738891	LATCH ROD																
--P0738892	2	P0738892	LATCH,TOP																
--P0738893	1	P0738893	TORSION SPRING																
--P0740321	1	P0740321	DOOR LATCH RH (GRAY)																
--P0740830	1	P0740830	TORSION SPRING LH MODULE																
--P0742722	1	P0742722	INSIDE DOOR PANEL RH																
--P0745365	1	P0745365	EMI GASKET, VERTICAL																
--P0745367	2	P0745367	EMI GASKET, HORIZONTAL (C42)																
NT9X6553	1	B0231164	CM/SLM BULKHEAD ASSY	SCC 00	0LE														
NT9X6553		B0231164	CM/SLM BULKHEAD ASSY RH																
-CRP14M050	6	A0317136	CONN ACCESSORY D SUB, 4-40 SCREWLOCK																
-FCP01C09N50G	1	A0336796	CONN FILTER D SUB, 375 PF ADAPTER																
-FCP01C25NB50G	2	A0316601	CONN FILTER D SUB, 375 PF ADAPTER																
-P0701815	3	P0701815	0.825 X 0.5 OBLONG GROMMET																
-P0732376	1	P0732376	W-CM BULKHEAD INTERFACE																
NT9X6553	1	B0231164	CM/SLM BULKHEAD ASSY	SCC 00	0RI														
NT9X6553		B0231164	CM/SLM BULKHEAD ASSY RH																
-CRP14M050	6	A0317136	CONN ACCESSORY D SUB, 4-40 SCREWLOCK																
-FCP01C09N50G	1	A0336796	CONN FILTER D SUB, 375 PF ADAPTER																
-FCP01C25NB50G	2	A0316601	CONN FILTER D SUB, 375 PF ADAPTER																
-P0701815	3	P0701815	0.825 X 0.5 OBLONG GROMMET																
-P0732376	1	P0732376	W-CM BULKHEAD INTERFACE																
NTZZ34PF	1	B0246189	+5/-5V POWER CONVERTER	SCC 00		0	1F												
Product	Qty	CPC	Title	CIL	REL														
NTZZ34PF		B0246189	GLOBAL +5V/+12V POWER CONVERTER	1		1													
-NT9X91AC	2	B0238874	GLOBAL +5/+12V POWER CONVERTER CP, -42V VIN(MIN),	13		9													
--A0252936	19	A0252936	DIODE SWITCH .2A 75V						0.006	Hitachi America Ltd Semiconductor & IC Division)	Philips Components	Rohm Electronics	Toshiba America Electronic Components Inc	Rectron USA	Fairchild Semiconductor	General Semiconductor Inc	Temic MHS (local supplier)		
--A0253336	6	A0253336	RES FILM 10 KOHM 1/4W 1%						0.006	Bradford Electronics Inc	KOA Speer Electronics Inc)	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd	BC Components	DIGIKEY CORPORATION	Arrow
--A0325296	1	A0325296	RES FILM 20 KOHM 1/4W 1/4%								KOA Speer Electronics Inc)	BC Components	Roederstein Electronics Inc		Dale Electronics Inc		BC Components		
--A0326970	1	A0326970	HYBRID MONITOR MODULE							C-MAC Microcircuits Inc)	C Mac Technology China Co Ltd)								

-A0326998	2	A0326998	RES FILM 39 OHM 5W 2%						Bradford Electronics Inc					Dale Electronics Inc	SP Int Ltd					
-CA10Z471W025S	2	A0275676	CAP AL RA 470UF 25V +100-10%						Nichicon America Corp	United Chemicon Inc)	BC Components	Elna America Inc	Panasonic Industrial Co Circuit Custom Components							
-CA11Z222M020S	4	A0326470	CAP AL RA 2200UF 20V 20%						Cornell Dubilier Electronics C/O Industrial Market)	Aerovox Inc)	United Chemicon Inc)									
-CA12X101M025S	2	A0285612	CAP AL RA 100UF 25V 20%						Elna America Inc)		United Chemicon Inc)	Panasonic Industrial Co Circuit Custom Components								
-CA12X220M100S	1	A0316973	CAP AL RA 22UF 100V 20%					0.061	Nichicon America Corp	Elna America Inc	United Chemicon Inc)	Panasonic Industrial Co Circuit Custom Components								
-CA12X221M063S	1	A0315241	CAP AL RA 220UF 63V 20%					0.118	Nichicon America Corp	Elna America Inc	United Chemicon Inc)	Panasonic Industrial Co Circuit Custom Components								
-CA16Z152M200S	3	A0361486	CAP AL RA 1500UF 200V 20%						Nichicon America Corp	Aerovox Inc	United Chemicon Inc)	Panasonic Industrial Co Circuit Custom Components	Elna America Inc							
-CB11X7RD105K	1	A0250006	CAP CER RA 1UF 50V 10%					0.15	Kemet Electronics	AVX Ceramic Corp	Murata Corp Of America	Syfer Technology Ltd	BC Components	C-MAC Industries						
-CB11X7RE105K	7	A0261756	CAP CER RA 1UF 50V 10%					0.195	Kemet Electronics	AVX Ceramic Corp	Murata Corp Of America	Syfer Technology Ltd	BC Components							
-CB12X7RD103K	1	A0297329	CAP CER RA 0.01UF 100V 10%					0.196	Kemet Electronics	AVX Ceramic Corp	Murata Corp Of America	Syfer Technology Ltd	BC Components							
-CB12Z5UE105Z	1	A0273866	CAP CER RA 1UF 100V +80-20%					0.138	Kemet Electronics	AVX Ceramic Corp	Murata Corp Of America	Syfer Technology Ltd	BC Components							
-CB17X7RA102K	2	A0248730	CAP CER AX 1NF 50V 10%					0.016	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components	United TRI Tech Corp (local)						
-CB17X7RA103K	2	A0248717	CAP CER AX 0.01UF 50V 10%					0.017	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB17X7RA222K	1	A0252190	CAP CER AX 2.2NF 50V 10%						Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB17X7RA223K	2	A0259403	CAP CER AX 0.022UF 50V 10%					0.02	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB17X7RA682K	1	A0255539	CAP CER AX 6.8NF 50V 10%					0.017	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB17X7RB104J	1	A0271564	CAP CER AX 100.0NF 5.0% 50.0V X7R 5.080MM LONG					0.033	Kemet Electronics	AVX Avio Excelente SA DE CV)										
-CB17X7RD104K	6	A0326980	CAP CER AX 100.0NF 10.0% 50.0V X7R 5.080MM LONG					0.023	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components	AVX Corp						
-CB18Z5UB104Z	13	A0298798	CAP CER AX 0.1UF 100V +80-20%					0.029	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB19C0GA101J	2	A0248729	CAP CER AX 100PF 50V 5%					0.019	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB19C0GA151J	2	A0254136	CAP CER AX 150PF 50V 5%					0.023	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB19C0GA331J	1	A0257230	CAP CER AX 330PF 50V 5%					0.019	Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CB19C0GA470J	2	A0254033	CAP CER AX 47PF 50V 5%						Kemet Electronics	AVX Avio Excelente SA DE CV)			BC Components							
-CP01Y2101F400	2	A0258625	CAP PP AX 2100PF 400V 1%						STK Electronics Inc	Wesco Electrical	Aerovox Inc									
-CP01Y2741F100	1	A0292142	CAP PP AX 2740PF 100V 1%						STK Electronics Inc	Wesco Electrical	Aerovox Inc		BC Components							
-CP01Y4701F100	1	A0270347	CAP PP AX 4.7NF 100V 1%					0.2	STK Electronics Inc	Wesco Electrical	Aerovox Inc	EPCOS AG	BC Components							
-CR03X104M250C	2	A0346063	CAP EMI RA 100.00NF 20.000% 275.0V 100C 15.0MM SPA					0.123	Roederstein Electronics Inc	Rifa AB	Nissei Arcotronics SPA	Wilhelm Westermann								
-CTP19P64ZNS9	2	A0326972	CONN RT HEADER, P. DIN 4X16 ARRAY 0.200 PITCH AU M						Thomas & Betts Corp	Siemens Canada Ltd	Conec Corp									
-NPS25026L2C	3	A0264710	CONN PCB TEST N/A ARRAY 0.400 PITCH AU FEMALE RT P						EF Johnson Co Custom Mfg Div	Jolo Industries Inc										
-NPS50897-03L01	12	A0367418	INT/EXT THREADED STANDOFF						Process Products Ltd	Fastbolt Corp										
-NT5L57AA	2	A0354716	HYBRID THICK FILM CUSTOM	5	D1				C-MAC Of America Inc	Universal Scientific Industry Co Ltd										
-NT5L5701	1	P0699911	PROCESS SUBSTRATE ASSYCTL	6	D1				No Data											
-NT6L36AA	1	A0381285	GLOBAL AUX. POWER MODULE						C-MAC Of America Inc											
-NT9V91AC	1	B0236884	GLOBAL +5/+12 POWER CONVERTER FIRMWARE	1	1				No Data (Nortel Prod)											
--QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16					0.7	Advanced Micro Devices Inc AMD											
--TT09KKS	1	A0405354	PROGRAMMED DEVICE		1				No Data (Nortel Prod)											
-NT9X9103	1	P0744094	GLOBAL +5/+12V POWER CONVERTER PCB (NT9X9103)	3	3				No Data (Nortel Prod)											
-NTH411AM	1	A0379127	INDUCTOR POWER TOROID						Pulse Engineering Inc											
-NTH484AA	1	A0379125	INDUCTOR POWER						Pulse Engineering Inc											
-NTH485AA	1	A0379126	INDUCTOR POWER						Pulse Engineering Inc											
-NTT402AQ	2	A0378038	CURRENT SENSE TRANSFORMER						Pulse Engineering Inc	Astec Advanced Power Systems (local)										
-NTT435AG	1	A0379128	XFORMER PUSH PULL						Pulse Engineering Inc											
-NTT435AH	1	A0379334	PUSH PULL TRANSFORMER						Pulse Engineering Inc											
-NTT441AP	2	A0378039	PULSE TRANSFORMER						Pulse Engineering Inc											
-P0116654	2	P0116654	MACHINE SCREW MACH SCR S PAN HEAD SLO						Fastbolt Corp	Townsend	Century Fasteners Corp									
-P0125084	2	P0125084	NUT, MATL CODE= S 288A FIN ISH, THD SIZE= 0.125-40						Fastbolt Corp	Townsend	Century Fasteners Corp									
-P0180927	12	P0180927	PHM SCREW 0.112-40 X 0.500 X 0.219					0.008	New York Fasteners NYF Corp	Federal Screw Works	Century Fasteners Corp	Townsend								
-P0182942	4	P0182942	LOCK WASHER					0.003	Process Products Ltd		Century Fasteners Corp									
-P0183093	6	P0183093	LOCK WASHER					0.006	Fastbolt Corp	Townsend	Century Fasteners Corp	TR Fastenings Ltd								

-P0249752	24	P0249752	LOCK WASHER						Process Products Ltd		Century Fasteners Corp									
-P0284133	2	P0284133	WASHER, NOMINAL #2, STEEL, 289A						Process Products Ltd		Century Fasteners Corp									
-P0290739	12	P0290739	PAN HD MACH SCREW						Fastbolt Corp		Century Fasteners Corp									
-P0297882	7	P0297882	RIVET,MATL CODE=S 289A FNSH,DIA=0.123,0.188 LG								Century Fasteners Corp									
-P0298848	6	P0298848	MACHINE SCREW MACH SCR S PAN HEAD SLO					0.03		Townsend	Century Fasteners Corp	New York Fasteners NYF Corp	Federal Screw Works							
-P0298849	6	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56					0.006	Mcmastercarr Supply Co	Townsend	Century Fasteners Corp	Fastbolt Corp	Speenaur Inc							
-P0356522	2	P0356522	WSR LOCK INT TOOTH 0.141-0.295 X 0.022					0.003	Fastbolt Corp	Townsend	Century Fasteners Corp									
-P0484370	12	P0484370	FLAT WSHR (MET) 0.127X 0.312X 0.028					0.006	Process Products Ltd	Federal Screw Works	Century Fasteners Corp									
-P0594488	6	P0594488	SHOULDER WASHER					0.034	Thermalloy Inc	Deskin Sales Corp	Century Fasteners Corp									
-P0613408	9	P0613408	PLASTITE 60-1, 0.123-20X0.312, HEX WSHR HD, STEEL,					0.023	Process Products Ltd	Continental Midland Inc	Century Fasteners Corp									
-P0667988	2	P0667988	TENSION WASHER						Process Products Ltd											
-P0668764	2	P0668764	FRONT LATCH					0.366	Brock Telecom Limited	SCI Systems Inc	Oneida Molded Plastics	Nikom Electronics Corp	Golden Enterprises	Duramold Plastics Inc						
-P0669003	9	P0669003	GASKET HOLDER						Electrical Equipment Co	BMP Metals Inc	Oneida Molded Plastics									
-P0672364	1	P0672364	LIGHT PIPE					0.634	Nortel Prod											
-P0676196	2	P0676196	KNURLED HEADER PIN					0.065	Century Fasteners Corp											
-P0697673	9	P0697673	EMI FINGER GASKET (POWER PACK)					0.202	Brock Telecom Limited	Commercial Spring & Tool Co Ltd	Golden Enterprises	SCI Systems Inc								
-P0705112	1	P0705112	STIFFENER	2	1				Nortel Prodl											
-P0705113	1	P0705113	FACEPLATE	1	0				Nortel Prodl											
-P0731493	1	P0731493	HEATSINK 2.80 INCHES	1	0				R Theta Inc	International Rectifier Corp										
-P0731757	1	P0731757	SILPAD	2	0				Nortel Prodl											
-P0734421	1	P0734421	HEATSINK	2	0				R Theta Inc	International Rectifier Corp										
-P0734422	1	P0734422	HEATSINK	1	0				R Theta Inc	International Rectifier Corp										
-P0734423	1	P0734423	SILPAD	3	0				Nortel Prodl											
-P0735527	1	P0735527	SILPAD	2	0				Nortel Prodl											
-P0746005	1	P0746005	FACEPLATE LABEL CAUTION (NT9X91AB/AC)	1	0				Nortel Prodl											
-QD-1N4004	1	A0243582	DIODE RECTIFIER 400V 1A					0.015	Microsemi Corp	Rohm Electronics	Rectron USA	Micro Commercial Components Corp	PAN JIT Int'l Inc	Fairchild Semiconductor	General Semiconductor Inc					
-QD-1N5231B	1	A0260857	DIODE ZENER <1W 5.1V						Microsemi Corp	Rohm Electronics	ON Semiconductor Semiconductor Components Ind L			Fairchild Semiconductor						
-QD-1N5234B	1	A0272773	DIODE ZENER <1W 6.2V					0.016	Microsemi Corp		ON Semiconductor Semiconductor Components Ind L	Micro Commercial Components Corp		Fairchild Semiconductor						
-QD-1N5239B	1	A0292817	DIODE ZENER, LOW POWER 1W						Microsemi Corp	Rohm Electronics	ON Semiconductor Semiconductor Components Ind L	Micro Commercial Components Corp		Fairchild Semiconductor						
-QD-1N5371B	1	A0275418	DIODE ZENER 1-6W 60V						Microsemi Corp		ON Semiconductor Semiconductor Components Ind L	Micro Commercial Components Corp								
-QD-550-2406	1	A0297222	DIODE, LED, RED, RT-ANG					0.084	Dialight	Data Display Products	Agilent Technologies			Fairchild Semiconductor						
-QD-80CNQ045	2	A0600142	DIODE, RECTIFIER, SCHOTTKY, 45V 80A						Microsemi Corp			Micro Commercial Components Corp								
-QD-82CNQ030	1	A0385819	DIODE, RECTIFIER, SCHOTTKY, 30V 80A						Microsemi Corp			Micro Commercial Components Corp								
-QDK64D	1	A0353482	DIODE RECTIFIER DUAL SCHOTTKY 40V 45A						International Rectifier	Nihon Inter Electronics Corp	Microsemi Corp									
-QDK64F	1	A0379581	DIODE RECTIFIER SCHOTTKY DUAL 100VR 30A						International Rectifier	Nihon Inter Electronics Corp										
-QFF4A1	1	A0259501	FUSE, FAST, AX, 0.5A, 125V, PICO					0.092	Bel Fuse Inc	Littelfuse Inc	San-O Industrial Corp	Cooper Industries Bussmann Division								
-QHP256A3	1	A0321594	INDUCTOR POWER						Maple Electronic Engineering	Pulse Engineering Inc										
-QM358E5	2	A0260352	IC LINEAR DUAL OP AMP					0.107	National Semiconductor	Texas Instruments	Philips Components	NEC Electronics Inc	STMicroelectronics Incorporated	ON Semiconductor Semiconductor Components Ind L						
-QM4N37E5	1	A0263562	OPTICAL COUPLER						Sharp Electronics Corp	Infineon Technologies Corp	Fairchild Semiconductor	Telefunken Corp								
-QMH11D1E5	2	A0314607	OPTICAL COUPLER							Infineon Technologies Corp	Fairchild Semiconductor									
-QT-2N5401	2	A0272904	XSISTOR PNP SM SIG AMPLIFIER					0.025	Philips Components	Toshiba America Electronic Components Inc	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor								
-QT-BS170	1	A0329089	TRANSISTOR MOSFET N-CH 60VDS 0.5A					0.067	Siliconix	Supertex Inc	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor								
-QT-IRFD113	1	A0312133	TRANSISTOR MOSFET N-CH						International Rectifier											
-QT-IRFP250	4	A0354743	TRANSISTOR MOSFET N-CH 200VDS 30A 0.085OHM						International Rectifier	Ixys Corp	ON Semiconductor Semiconductor Components Ind L	Intersil Corporation	Fairchild Semiconductor	STMicroelectronics Incorporated						
-QT-PN2222A	5	A0264620	XSTR NPN SMALL SIGNAL GENERAL 40V 0.6A THRU-HOLE					0.024	Rohm Electronics	Philips Components	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor								
-QT-PN2907A	6	A0272995	TRANSISTOR PNP SMALL SIGNAL 60VCE 0.6A					0.024	Rohm Electronics	Philips Components	ON Semiconductor Semiconductor Components Ind L	Fairchild Semiconductor	General Semiconductor							
-QV-V100ZA15	1	A0279964	VARISTOR SUR SUPP						Harris Corp	EPCOS AG	BC Components	AVX Corp								
-R0113993	4	R0113993	HOOK-UP WIRE, SINGLE, UL 1430, CSA REW-105, 26AWG						Judd Wire Inc	BICC General										

--RB14H2C05	1	A0291881	RELAY FS FORM 2C 5V					Aromat Corp	Omron Electronics Inc	Matsushita Electric Works Ltd				
--RB14H2C12S1	1	A0293296	RELAY FS FORM 2C 12V				1.237	Aromat Corp	NEC Corp Electromechanical Devices					
--RB14H2C24	2	A0287523	RELAY FS FORM 2C 24V				1.04	Aromat Corp	Omron Electronics Inc	Matsushita Electric Works Ltd				
--RB17H2C48	1	A0355400	RLY FL SPG PLSTC SLD PCB 48.0V 2C					Aromat Corp						
--RF06BW1000F	3	A0271689	RES FILM 100.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW1001F	15	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW1003F	5	A0253438	RES, FILM, 100000.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW10R0F	3	A0264277	RES FILM 10.00 OHMS .250W 1.0%				0.006		KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW1132F	1	A0266457	RES FILM 11300.00 OHMS .250W 1.0%					Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW1302F	2	A0253432	RES, FILM, 13000.000 OHMS .250 POWER, 1.00 TOL					Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW1502F	2	A0253457	RES, FILM, 15000.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW1623F	2	A0271780	RES FILM 162000.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW1783F	1	A0271796	RES FILM AX 178.0 KOHM 0.25W 1.0% 100 PPM/C					Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW2001F	2	A0270348	RES FILM 2000.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW2050F	1	A0265138	RES FILM 205.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW20R0F	4	A0271819	RES FILM 20.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW2212F	1	A0258765	RES, FILM, 22100.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW2431F	1	A0252978	RES, FILM, 2430.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW2551F	1	A0271858	RES FILM 2550.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW2613F	1	A0271862	RES FILM 261000.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW3320F	1	A0253463	RES, FILM, 332.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW3322F	1	A0255550	RES, FILM, 33200.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW3573F	1	A0296882	RES FILM 357000.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW4321F	1	A0271938	RES FILM 4320.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW43R2F	1	A0271935	RES FILM 43.200 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW4750F	1	A0271963	RES FILM 475.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW4751F	1	A0258297	RES, FILM, 4750.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW4752F	2	A0258298	RES, FILM, 47500.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW5110F	1	A0263182	RES FILM 511.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW5111F	4	A0257178	RES, FILM, 5110.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW5112F	4	A0253436	RES, FILM, 51100.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW5621F	1	A0263019	RES FILM 5620.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW56R2F	1	A0271996	RES FILM 56.200 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW6040F	1	A0258750	RES, FILM, 604.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW6192F	1	A0272008	RES FILM 61900.00 OHMS .250W 1.0%				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW6810F	1	A0259321	RES, FILM, 681.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF06BW9091F	1	A0253437	RES, FILM, 9090.000 OHMS .250 POWER, 1.00 TOL				0.006	Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc	Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF08BW15R0F	1	A0273391	RES FILM 15.00 OHMS .500W 1.0%					Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components		Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF08BW7500F	1	A0273744	RES FILM 750.00 OHMS .500W 1.0%					Bradford Electronics Inc	KOA Speer Electronics Inc	BC Components		Rohm Electronics	Dale Electronics Inc	SP Int Ltd
--RF14BX4301G	2	A0264251	RES FILM 4300.00 OHMS 2.00W 2.0%					Bradford Electronics Inc	KOA Speer Electronics Inc		Roederstein Electronics Inc		Dale Electronics Inc	SP Int Ltd
--RF16BX1501G	1	A0261741	RES FILM 1500.00 OHMS 3.00W 2.0%					Bradford Electronics Inc					Dale Electronics Inc	SP Int Ltd
--RF16BX1801G	1	A0234494	RES, FILM, 1800.000 OHMS 3.000 POWER, 2.00 TOL					Bradford Electronics Inc					Dale Electronics Inc	SP Int Ltd
--RF16BX30R0G	1	A0274544	RES FILM 30.00 OHMS 3.00W 2.0%					Bradford Electronics Inc					Dale Electronics Inc	SP Int Ltd
--RF41BS5111C	3	A0265134	RES FILM 5110.00 OHMS .250W .25%						KOA Speer Electronics Inc	BC Components	Roederstein Electronics Inc		Dale Electronics Inc	SP Int Ltd
--RP01D1C024S	1	A0327183	RELAY POWER 1 FORM C 24V					Aromat Corp						
--SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION				0.025	Robinson Nugent Inc	Framatome Connectors USA Inc	Thomas & Betts Corp				
--SPC27C9R5PBS	1	A0382054	SW ROCKER 2PDT (ON)-ON-(ON) RT PC TERM					C&K Components Inc						
--TP01BZ200P070E	2	A0381067	RESISTOR, THERMISTOR					Keystone Carbon Co						
NTZZ34PE	1	B0246101	+5/-5V POWER CONVERTER	SCC 00	0	4F								
Product	Qty	CPC	Title	OIL	REL									
NTZZ34PE		B0246101	GLOBAL +5V/-5V POWER CONVERTER	1	1									
-NTDX15AB	2	B0235734	GLOBAL POWER CONVERTER +/- 5V CP, -42V VIN(MIN), -	10	18									
--A0252936	15	A0252936	DIODE SWITCH .2A 75V											
--A0253336	4	A0253336	RES FILM 10 KOHM 1/4W 1%											
--A0325296	1	A0325296	RES FILM 20 KOHM 1/4W 1/4%											
--A0326970	1	A0326970	HYBRID MONITOR MODULE											
--CA10Z221W050S	1	A0279996	CAP AL RA 220UF 50V +100-10%											
--CA10Z471W025S	3	A0275676	CAP AL RA 470UF 25V +100-10%											
--CA11Z222M020S	4	A0326470	CAP AL RA 2200UF 20V 20%											
--CA12X101M025S	1	A0285612	CAP AL RA 100UF 25V 20%											
--CA12X220M100S	1	A0316973	CAP AL RA 22UF 100V 20%											
--CA12X221M063S	1	A0315241	CAP AL RA 220UF 63V 20%											
--CA12X3R3M050S	1	A0287244	CAP AL RA 3.3UF 50V 20%											
--CA12X471M100SA	1	A0361698	CAP AL RL 470.0UF 20% 100.0V 85C 7.5MM SPAN											
--CB12Z5UE105Z	5	A0273865	CAP CER RA 1UF 100V +80-20%											
--CB17X7RA153K	1	A0252342	CAP CER AX 15NF 50V 10%											
--CB17X7RA183K	1	A0252614	CAP CER AX 0.018UF 50V 10%											
--CB17X7RA222K	2	A0252190	CAP CER AX 2.2NF 50V 10%											
--CB17X7RA332K	1	A0252340	CAP CER AX 3.3NF 50V 10%											
--CB17X7RA471K	1	A0252339	CAP CER AX 470PF 50V 10%											
--CB17X7RA472K	3	A0252341	CAP CER AX 4.7NF 50V 10%											

--CB17Z5UB224Z	1	A0297786	CAP CER AX 0.22UF 50V +80-20%			
--CB17Z5UB334Z	1	A0298794	CAP CER AX 0.33UF 50V +80-20%			
--CB17Z5UB474Z	1	A0271556	CAP CER AX 0.47UF 50V			
--CB18Z5UB104Z	17	A0298798	CAP CER AX 0.1UF 100V +80-20%			
--CB19C0GA470J	1	A0254033	CAP CER AX 47PF 50V 5%			
--CB19C0GA681J	1	A0267173	CAP CER AX 680PF 50V 5%			
--CM06Y106J100	4	A0293096	CAP PE RA 10UF 100V 5%			
--CM06Y685K063D	3	A0361697	CAP PE RA 6.8UF 63V 10%			
--CP01Y2101F400	1	A0258625	CAP PP AX 2100PF 400V 1%			
--CR03X104M250C	2	A0346063	CAP EMI RA 100.00NF 20.000% 275.0V 100C 15.0MM SPA			
--CTP19P64ZNS9	2	A0326972	CONN RT HEADER, P. DIN 4X16 ARRAY 0.200 PITCH AU M			
--NPS25028L2C	3	A0264710	CONN PCB TEST N/A ARRAY 0.400 PITCH AU FEMALE RT P			
--NPS50024-01L07	1	A0354421	HEAT SINK			
--NPS50897-03L01	8	A0367418	INT/EXT THREADED STANDOFF			
--NT5L57AA	1	A0354716	HYBRID THICK FILM CUSTOM	5	D1	
---NT5L5701	1	P0699911	PROCESS SUBSTRATE ASSYCTL	6	D1	
--NT6L36AA	1	A0381285	GLOBAL AUX. POWER MODULE			
--NTDV15AB	1	B0235735	GLOBAL POWER CONVERTER +/- 5V CP FIRMWARE	2		1
---QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16			
---QM6331L-55P503	1	A0395909	PROGRAMMED DEVICE	JJW		1
--NTDX1502	1	P0735409	GLOBAL POWER CONVERTER +/- 5V PCB (NTDX1502)	1		1
--NTH403AG	2	A0363105	INDUCTOR POWER			
--NTH414AC	1	A0363106	INDUCTOR POWER			
--NTH444AB	1	A0352158	INDUCTOR POWER			
--NTT402AX	2	A0381972	CURRENT SENSE TRANSFORMER			
--NTT433AK	1	A0381969	XFMR POWER CONVERTER THRU-HOLE 2 OUTPUTS			
--NTT441AR	2	A0381975	DRIVER TRANSFORMER			
--P0116654	2	P0116654	MACHINE SCREW MACH SCR S PAN HEAD SLO			
--P0125084	2	P0125084	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.125-40			
--P0182942	4	P0182942	LOCK WASHER			
--P0183093	6	P0183093	LOCK WASHER			
--P0247375	1	P0247375	NUT,HEX,MACHINE SCREW, 0.112-40			
--P0249752	21	P0249752	LOCK WASHER			
--P0284133	2	P0284133	WASHER, NOMINAL #2, STEEL, 289A			
--P0290739	13	P0290739	PAN HD MACH SCREW			
--P0298848	6	P0298848	MACHINE SCREW MACH SCR S PAN HEAD SLO			
--P0298849	6	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56			
--P0356522	2	P0356522	WSR LOCK INT TOOTH 0.141-0.295 X 0.022			
--P0531422	8	P0531422	PAN HD MACH SCR #4-40 X			
--P0594488	6	P0594488	SHOULDER WASHER			
--P0613408	9	P0613408	PLASTITE 60-1, 0.123-20X0.312, HEX WSHR HD, STEEL,			
--P0667988	2	P0667988	TENSION WASHER			
--P0668764	2	P0668764	FRONT LATCH			
--P0669003	9	P0669003	GASKET HOLDER			
--P0672364	1	P0672364	LIGHT PIPE			
--P0676196	2	P0676196	KNURLED HEADER PIN			
--P0697673	9	P0697673	EMI FINGER GASKET (POWER PACK)			
--P0705113	1	P0705113	FACEPLATE	1		0
--P0706193	1	P0706193	7INCH HEATSINK	2		1
--P0706194	1	P0706194	STIFFENER	2		1
--P0706195	1	P0706195	3INCH HEATSINK	2		1
--P0706245	1	P0706245	3INCH SILPAD	2		1
--P0706246	1	P0706246	7INCH SILPAD	2		1
--P0707941	1	P0707941	DESIGN LABEL (NTDX15AA)	2		1
--P0719608	1	P0719608	RM12 INSULATING WASHER			
--P099P855	7	P099P855	RIVET, MATL CODE= A 1842A FINISH, DIA= 0.123 0.188			
--QD-1N4004	1	A0243582	DIODE RECTIFIER 400V 1A			
--QD-1N5229B	1	A0284027	DIODE ZENER <1W 4.3V			
--QD-1N5231B	2	A0260857	DIODE ZENER <1W 5.1V			
--QD-1N5240B	1	A0266871	DIODE ZENER <1W 10V			
--QD-1N5818	5	A0262959	DIODE RECT SCHOTTKY 1A 30V			
--QD-60CNQ045	2	A0361914	DIODE DUAL SCHOTTKY 60A 45V COMM. CATHODE			
--QDK64F	2	A0379581	DIODE RECTIFIER SCHOTTKY DUAL 100VR 30A			
--QDL40A	1	A0379801	SEMICONDUCTOR, LED, RED			
--QFF4A20	1	A0319216	FUSE MINI FAST 0.250A 125V			
--QHP256A3	1	A0321594	INDUCTOR POWER			
--QM-CNY17-2E5	1	A0337139	IC OPTOCOUPLER			
--QM4N37E5	1	A0263562	OPTICAL COUPLER			
--QMH11D1E5	1	A0314607	OPTICAL COUPLER			
--QMS143A	1	A0326969	HYBRID PWM MODULE	1	D2	
--QT-2N5401	1	A0272904	XSISTOR PNP SM SIG AMPLIFIER			
--QT-IRFP250	4	A0354743	TRANSISTOR MOSFET N-CH 200VDS 30A 0.085OHM			
--QT-IRFZ40	2	A0323914	XSTR MOSFET N-CH ENHANCE PWR 50V 0.028 OHM			
--QT-MJE200	2	A0361903	TRANSISTOR NPN 25V 5A			
--QT-MJE210	2	A0361904	TRANSISTOR PNP 25V 5A			
--QT-PN2222A	4	A0264620	XSTR NPN SMALL SIGNAL GENERAL 40V 0.6A THRU-HOLE			
--QT-PN2907A	2	A0272995	TRANSISTOR PNP SMALL SIGNAL 60VCE 0.6A			
--QT-TIP122	1	A0293001	XSISTOR NPN PWR DARLINGTON 100V			
--QV-V100ZA15	1	A0279964	VARISTOR SUR SUPP			
--RB14H2C05	1	A0291881	RELAY FS FORM 2C 5V			
--RB14H2C12	1	A0296957	RELAY FS FORM 2C 12V			
--RB14H2C24S1	2	A0327084	RELAY FS 2 FORM C 24V			
--RB17H2C48	1	A0355400	RLY FL SPG PLSTC SLD PCB 48.0V 2C			
--RF06BW1000F	1	A0271689	RES FILM 100.00 OHMS .250W 1.0%			
--RF06BW1001F	7	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1003F	3	A0253438	RES, FILM, 100000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW10R0F	5	A0264277	RES FILM 10.00 OHMS .250W 1.0%			
--RF06BW1103F	1	A0255636	RES, FILM, 110000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1301F	2	A0255546	RES, FILM, 1300.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1303F	1	A0254530	RES, FILM, 130000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1503F	1	A0259310	RES, FILM, 150000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1621F	1	A0259306	RES, FILM, 1620.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW2001F	2	A0270348	RES FILM 2000.00 OHMS .250W 1.0%			
--RF06BW20R0F	4	A0271819	RES FILM 20.00 OHMS .250W 1.0%			
--RF06BW2210F	1	A0266442	RES FILM 221.00 OHMS .250W 1.0%			
--RF06BW2212F	1	A0258765	RES, FILM, 22100.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW2613F	1	A0271862	RES FILM 261000.00 OHMS .250W 1.0%			
--RF06BW2671F	2	A0258292	RES, FILM, 2670.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW2672F	1	A0258767	RES, FILM, 26700.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW3010F	1	A0271887	RES FILM 301.00 OHMS .250W 1.0%			
--RF06BW3012F	1	A0271888	RES FILM 30100.00 OHMS .250W 1.0%			
--RF06BW30R9F	1	A0271882	RES FILM 30.900 OHMS .250W 1.0%			
--RF06BW3320F	1	A0253463	RES, FILM, 332.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW4321F	2	A0271938	RES FILM 4320.00 OHMS .250W 1.0%			
--RF06BW4751F	1	A0258297	RES, FILM, 4750.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW5111F	6	A0257178	RES, FILM, 5110.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW5112F	1	A0253436	RES, FILM, 51100.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW5113F	1	A0271982	RES FILM 511000.00 OHMS .250W 1.0%			
--RF06BW51R1F	2	A0271978	RES FILM 51.100 OHMS .250W 1.0%			
--RF06BW5621F	1	A0263019	RES FILM 5620.00 OHMS .250W 1.0%			
--RF06BW6652F	1	A0266490	RES FILM 66500.00 OHMS .250W 1.0%			
--RF06BW6811F	1	A0258691	RES, FILM, 6810.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW7501F	1	A0253468	RES, FILM, 7500.000 OHMS .250 POWER, 1.00 TOL			
--RF08BW15R0F	2	A0273391	RES FILM 15.00 OHMS .500W 1.0%			
--RF08BW1R00F	1	A0272199	RES FILM AX 1.0 OHM 0.50W 1.0% 100 PPM/C			
--RF08BW1R10F	1	A0272200	RES FILM 1.100 OHMS .500W 1.0%			
--RF12BW2611F	1	A0249401	RES FILM AX 2.6 KOHM 1.00W 1.0% 100 PPM/C			
--RF16BX15R0G	1	A0271116	RES FILM 15.00 OHMS 3.00W 2.0%			
--RF18BX1401F	1	A0274415	RES FILM AX 1.4 KOHM 5.00W 1.0% 200 PPM/C			
--RF19BX24R0J	1	A0236443	RES, FILM, 24.000 OHMS 7.000 POWER, 5.00 TOL			
--RF22BX10R0G	1	A0255742	RES, FILM, 10.000 OHMS 3.000 POWER, 2.00 TOL			

--RF41BS5111C	2	A0265134	RES FILM 5110.00 OHMS .250W .25%			
--RP01D1C024S	1	A0327183	RELAY POWER 1 FORM C 24V			
--SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION			
--SPC27C9R5PBS	1	A0382054	SW ROCKER 2PDT (ON)-ON-(ON) RT PC TERM			
--TP01BZ200P070E	2	A0381067	RESISTOR, THERMISTOR			
NTZZ34JC	1	B0246099	SYSTEM LOAD MODULE III	SCC 00	0	7F
Eng Code	QTY	CPC	DESCRIPTION	OIL	REL	
NTZZ34JC		B0246099	SYSTEM LOAD MODULE III	1	1	
-NT9X44AD	2	B0242458	SYSTEM LOAD MODULE (SLM3)	13	49	
--NT9X4420	1	B0242459	SLM3 SUB-ASSEMBLY	13	49	
---DPHD3.5IN4.55GBSCSI-2	1	A0736160	FIXED DISK 3.5IN 4.55GB SCSI-2 8-BIT IFACE			
---DPTD5.25IN525MBL2	1	A0739429	TAPE DRIVE, 525MB, QIC, 5 1/4" FORM, SPECIAL			
---NT9X4411	1	B0229293	SLMII WELDED ASSEMBLY	1	1	
----NT9X4412	1	B0231175	SYSTEM LOAD MODULE SLM1A FRAME ASSEMBLY	1	1	
-----P0610192	2	P0610192	STANDOFF, SELF-CLINCH, STEEL 289A, (PENN ENG. SO-6			
-----P0710124	1	P0710124	SLM 1A FRAMEWORK	1	0	
-----P0719081	7	P0719081	STANDOFF SELF-CLINCH, FLUSH-MOUNT, STEEL, FIN:289A			
-----P097C747	1	P097C747	CLINCH NUT, (PENN ENG. S-632-2-ZC)			
----P0710126	1	P0710126	FRONT SHIELD	1	0	
----P0710127	1	P0710127	CENTRE SHIELD	1	0	
----P0710128	1	P0710128	MOUNTING BRACKET	1	0	
----P0714175	1	P0714175	HANDLE BRACKET	1	0	
---NT9X4413	1	B0231176	SLM 1A FRONT SHIELD ASSY	1	1	
----P0691898	4	P0691898	STANDOFF SELF-CLINCH, BLIND THD, STEEL, FIN: 289A,			
----P0710503	1	P0710503	FRONT FACEPLATE	1	0	
---NT9X4414	2	B0231177	SLM 1A MOUNTING BRACKET ASSEMBLY	1	1	
----R0105561	1	R0105561	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA			
----R0112723	3	R0112723	RECTANGULAR EMI MONEL WIREGASKET WITH NEOPRENE SPO			
---NT9X4418	2	B0232350	POWER CABLE ASSEMBLY	4	2	
----CRP13CS1420BQ1	4	A0352128	CONN CONTACT UNIV MATE-N-LOK 14-20 SN CRIMP			
----CRP13H04MN	1	A0290886	CONN POWER UNIV MATE-N-LOK 1X4 ARRAY MALE NA			
----CRP13M026	4	A0322204	CONN CONTACT UNIV MATE-N-LOK 14-20 SN CRIMP			
----CRP21H04RSQ1	1	A0352127	CONN POWER COML MATE-N-LOK 1X4 ARRAY FEMALE			
----R0113565	0.457	R0113565	HKUP WIRE 14AWG SGLE YEL 41X30 TIN CU INS XLPVC UL			
----R0113702	1.372	R0113702	HKUP WIRE 14AWG SGLE BLK 19X27 TIN CU XLPVC INS UL			
---NT9X4422	1	B0249234	SLM-3 CABLE ASSEMBLY	1	1	
----CFC04V50A00	2	A0299812	CONN FCABLE PLUG AND RECEPTACLE 2X25 0.100 AU FEMA			
----CFC06A50B2A	1	A0314475	CONN FCABLE PLUG AND RECEPTACLE D 0.109 AUMALE IDT			
----CFC09M006	2	A0297201	CONN HOOD FLAT CABLE IDT N/A ARRAY			
----R0106327	30	R0106327	FLAT CABLE, 28AWG 1X28AWG CU CONDUCTOR,CONST=50 CO			
----R0114617	1	R0114617	DOCUMENTATION, LABEL, TAG			
---P0242132	15	P0242132	WASHER, SPRING HELICAL .168 X 0.296 X 0.040			
---P0252552	4	P0252552	WASHER			
---P0356522	4	P0356522	WSR LOCK INT TOOTH 0.141-0.295 X 0.022			
---P0368690	2	P0368690	NUT, MATL CODE= S 289A FIN			
---P0567211	4	P0567211	SHOULDER BUSHING .125LG A=.290 B=.046			
---P0633700	2	P0633700	CABLE TIE, LOCKING. MAX BUNDLE DIAMETER: 0.87", LE			
---P0633703	2	P0633703	CABLE TIE, MAT: NYLON. FLAME-RETARDANT, PLT4S-M69			
---P0650201	1	P0650201	COMPRESION SPRING, MW, SQUARED AND GND ENDS 0.300			
---P0661457	15	P0661457	SCREW MACH (HEX WASHER			
---P0672388	1	P0672388	FILLER BOARD (NT9X19AA)	5	0	
---P0682717	1	P0682717	FOLDING HANDLE, 4" CENTER MOUNTING HOLES .500" FOL			
---P0693104	1	P0693104	SAFETY CATCH	1	D1	
---P0710125	1	P0710125	REAR ACCESS PANEL	1	0	
---P0711386	1	P0711386	COPPER FINGER GASKET	1	0	
---P0719024	7	P0719024	HEX WSHR HEAD, 138-32X.625			
--NT9X4421	1	B0242422	SLM III CP	13	49	
---A0252936	1	A0252936	DIODE SWITCH .2A 75V			
---A0253336	3	A0253336	RES FILM 10 KOHM 1/4W 1%			
---A0355422	1	A0355422	MICRO CIRCUIT (SEMI CUS) LINK HANDLER GATE ARRAY			
---CA14X100M050S	1	A0285220	CAP AL AX 10.0UF 20.000% 50.0V 85C			
---CA14X220M010S	1	A0293015	CAP AL AX 22.0UF 20.000% 10.0V 85C			
---CA16X103M016SL	3	A0314537	CAP AL RA 10000UF 16V 20%			
---CB17X7RA103J	22	A0271560	CAP CER AX 0.01UF 50V 5%			
---CB17X7RB104J	23	A0271564	CAP CER AX 100.0NF 5.0% 50.0V X7R 5.080MM LONG			
---CB17Z5UB474Z	1	A0271556	CAP CER AX 0.47UF 50V			
---CB18X7RA472K	10	A0243837	CAP CER AX 4.7NF 10.0% 100.0V X7R 4.310MM LONG			
---CRP04P50V50G	1	A0336620	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE STR PCB			
---CRP13K04MN	3	A0291900	CONN POWER UNIV MATE-N-LOK 1X4 ARRAY MALE STR PCB			
---CRP14M080	2	A0329592	D SUB LATCHING POST ASSEMBLY KIT			
---CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F			
---NPS50419-01L3	1	A0319009	T 1-3/4 CLIP AND RING MTG HARDWARE			
---NR12Q16B1001G	6	A0255715	RES, NETWORK, 1000.000 OHMS .100 POWER, 2.00 TOL			
---NT9V4421	1	B0242423	SYSTEM LOAD MODULE (SLM3) F/W	4	4	
----A0346100	3	A0346100	MC			
----QM27C512-20P5	1	A0355076	IC CMOS UV EPROM 64K X 8 200NS			
----QM27C512-20P503RZC	1	A0721041	PROGRAMMED DEVICE FOR NT9V4421		1	
----QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16			
----QM6331L-55P503RNJ	1	A0634547	PROGRAMMED DEVICE FOR NT9X4421		1	
----QMPAL20L8BCP503RNF	1	A0634543	PROGRAMMED DEVICE FOR NT9X4421		1	
----QMPAL20L8BCP503RNG	1	A0634544	PROGRAMMED DEVICE FOR NT9X4421		1	
----QMPAL20L8BCP503RNH	1	A0634545	PROGRAMMED DEVICE FOR NT9X4421		1	
---NT9X4403	1	P0661788	SYSTEM LOAD UNIT PCB	4	5	
---P0038869	1	P0038869	PAN HD SLT MACH SCREW, 086-56 X 0.312, STEEL, 289A			
---P0183093	5	P0183093	LOCK WASHER			
---P0249752	2	P0249752	LOCK WASHER			
---P0298849	6	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56			
---P0552373	2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR			
---P0613092	2	P0613092	LED MOUNT SPCR 0.120ID 0.187OD 0.235LG, NYLON			
---P0668559	2	P0668559	4X90 MOUNTING BLOCK			
---P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI			
---P0668561	2	P0668561	KEY OCTAGON FOR A0324156			
---P0668764	2	P0668764	FRONT LATCH			
---P0668765	2	P0668765	INSERTION AID			
---P0668766	1	P0668766	FRONT FACEPLATE			
---P0668767	1	P0668767	SHEAR PLATE			
---P0682710	10	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)			
---P0697674	7	P0697674	EMI FINGER GASKET			
---P0706106	1	P0706106	LED SLM II LABEL	1	D1	
---QD-1N4004	1	A0243582	DIODE RECTIFIER 400V 1A			
---QD-1N4731A	1	A0273094	DIODE ZENER 1W 4.3V			
---QD-1N5227B	2	A0277534	DIODE ZENER <1W 3.6V			
---QD-HLMP4719	1	A0329241	DIODE LED YELLOW			
---QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO			
---QFF4A8	1	A0259508	FUSE, FAST, AX, 7A, 125V, PICO			
---QM100DLP5	1	A0262491	IC DELAY LINE DIGITAL 5 EQUAL TAPS 20 TO 100 NS			
---QM200DLP5	2	A0275942	IC DELAY LINE DIGITAL 5 EQUAL TAPS 40 TO 200 NS			
---QM250DLP5	1	A0262958	IC DELAY LINE DIGITAL 5 EQUAL TAPS 50 TO 250 NS			
---QM3196-122P5	1	A0740661	16 BIT MICROPROCESSOR WITH 8-BIT BUS WITH SOCKET (			
---QM319P5	1	A0263691	IC LINEAR DUAL COMPRTR			
---QM3347-122P5	1	A0740659	IC NMOS SCSI BUS INTFC			
---QM50DLP5	1	A0276161	IC DELAY LINE DIGITAL 5 EQUAL TAPS 10 TO 50 NS			
---QM62256L-10P5	1	A0345670	MEMORY IC, CMOS SRAM, 32KX8, 100NS, DIL28(600MIL)			
---QM7204-50P5	2	A0640708	IC, CMOS, ASYNCHRONOUS FIFO, 4KX9, 50NS, DIL28			
---QM72C555E5	1	A0336055	IC LINEAR GP TIMER			
---QM74ALS133P5	1	A0311975	IC ALSTTL NAND 13-IN			
---QM74ALS244P5	4	A0292052	IC ALSTTL OCTAL BUFF 3S			
---QM74ALS245P5	2	A0292053	IC ALSTTL OCTAL BUS XCVR 3S			
---QM74ALS873P5	1	A0316992	IC ALSTTL DUAL LATCH D 4-BIT			
---QM74F00P5	4	A0277832	IC FTTL QUAD NAND			
---QM74F02P5	1	A0287320	IC FTTL QUAD NOR			

—QM74F04P5	1	A0287319	IC FTTL HEX INV			
—QM74F08P5	6	A0287318	IC FTTL QUAD AND			
—QM74F10P5	1	A0277833	IC FTTL TRIPLE NAND 3-IN			
—QM74F11P5	1	A0287317	IC FTTL TRIPLE AND 3-IN			
—QM74F138P5	3	A0291288	IC FTTL DEMUX 3 - 8			
—QM74F163P5	1	A0291292	IC FTTL COUNTER 4-BIT BIN			
—QM74F193P5	6	A0326871	IC FTTL COUNTER BIN UP/DN			
—QM74F240P5	1	A0290926	IC FTTL OCTAL BUFF INV 3S			
—QM74F244P5	3	A0290927	IC FTTL OCTAL BUFF 3S			
—QM74F27P5	1	A0329870	IC FTTL TRIPLE NOR 3-IN			
—QM74F280P5	1	A0291294	IC FTTL PARITY GENERATOR 9-BIT			
—QM74F32P5	8	A0287315	IC FTTL QUAD OR			
—QM74F373P5	1	A0292423	IC FTTL OCTAL LATCH D 3S			
—QM74F38P5	1	A0316946	IC FTTL QUAD NAND BUFF OC			
—QM74F74P5	11	A0287314	IC FTTL DUAL FF D			
—QM74LS00P5	2	A0252814	IC LSTTL QUAD NAND			
—QM74LS02P5	2	A0252815	IC LSTTL QUAD NOR			
—QM74LS04P5	7	A0252816	IC LSTTL HEX INV			
—QM74LS09P5	1	A0265006	IC LSTTL QUAD AND OC			
—QM74LS126P5	2	A0260380	IC LSTTL QUAD BUFF 3S			
—QM74LS139P5	1	A0257853	IC LSTTL DUAL DEMUX 2 - 4			
—QM74LS148P5	1	A0272697	IC LSTTL OCTAL PRIORITY ENCODER 8 - 3			
—QM74LS14P5	1	A0257852	IC LSTTL HEX INV SCHMITT TRIGGER			
—QM74LS164P5	1	A0252998	IC LSTTL SHIFT REG 8-BIT S-P			
—QM74LS174P5	2	A0252831	IC LSTTL HEX FF D			
—QM74LS175P5	2	A0252832	IC LSTTL QUAD FF D			
—QM74LS21P5	1	A0252990	IC LSTTL DUAL AND 4-IN			
—QM74LS273P5	1	A0263810	IC LSTTL OCTAL FF D			
—QM74LS279P5	3	A0253318	IC LSTTL QUAD LATCH SR			
—QM74LS280P5	2	A0263635	IC LSTTL PARITY GENERATOR 9-BIT			
—QM74LS32P5	3	A0252823	IC LSTTL QUAD OR			
—QM74LS368P5	1	A0253302	IC LSTTL HEX BUFF INV 3S			
—QM74LS373P5	5	A0262955	IC LSTTL OCTAL LATCH D 3S			
	4	A0262368	IC LSTTL DUAL COUNTER BIN			
—QM74LS646P5	2	A0287557	IC LSTTL OCTAL BUS XCVR 3S			
—QM74LS74P5	2	A0252825	IC LSTTL DUAL FF D			
—QMTL7702AE5	1	A0327091	MICROCIRCUIT, LINEAR SUPPLY VOLTAGE SUPERVISOR			
—QNM1100A9	1	A0270182	IC CRYSTAL OSCILLATOR 16.000MHZ			
—QT-PN2222A	1	A0264620	XSTR NPN SMALL SIGNAL GENERAL 40V 0.6A THRU-HOLE			
—R0106318	0.2	R0106318	HOOK-UP WIRE, 30AWG SGLE 1X30 AG CU PVDF BLU UL142			
—R0106319	0.2	R0106319	HOOK-UP WIRE, 30AWG SGLE 1X30 AG CU PVDF RED UL 14			
—RF06BW1001F	5	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL			
—RF06BW1004F	1	A0260902	RES FILM AX 1.00 MOHM 0.250W 1.00% 100 PPM/C			
—RF06BW1501F	1	A0255782	RES, FILM, 1500.000 OHMS .250 POWER, 1.00 TOL			
—RF06BW3921F	1	A0255793	RES, FILM, 3920.000 OHMS .250 POWER, 1.00 TOL			
—RF06BW5621F	2	A0263019	RES FILM 5620.00 OHMS .250W 1.0%			
—RF06BW7151F	1	A0272031	RES FILM 7150.00 OHMS .250W 1.0%			
—RF06BW7500F	2	A0253337	RES, FILM, 750.000 OHMS .250 POWER, 1.00 TOL			
—RF06BW8251F	1	A0272058	RES FILM 8250.00 OHMS .250W 1.0%			
—RF12BW1300F	1	A0249307	RES FILM AX 130.0 OHM 1.00W 1.0% 100 PPM/C			
—RF49BW0000F	1	A0296948	RES FILM AX 0.0 OHM 0.25W 1.0% 100 PPM/C			
—SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION			
—SCT01B324	2	A0323911	SOCKET DIP 24 POSITION,RIGID INSULATION			
—SCT01B628	1	A0286209	SOCKET DIP 28 POSITION,RIGID INSULATION			
—SIC13B085Q1	1	A0360627	SOCKET PGA 85 POSITION,REMOVABLE INSULATION			
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	12F
Product	Qty	CPC	Title	CIL	REL	
NT9X19AA		B0221845	FILLER CIRCUIT PACK	6	6	
-P0668764	2	P0668764	FRONT LATCH			
-P0668766	1	P0668766	FRONT FACEPLATE			
-P0672388	1	P0672388	FILLER BOARD (NT9X19AA)	5	0	
-P0675738	1	P0675738	LOGIC CARD CENTER LABEL	2	0	
-P0682710	4	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)			
-P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1.	2	0	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	12F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	13F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	13F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	14F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	14F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	15F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	15F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	16F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	16F
NT9X86AB	1	B0240643	DUAL PORT MESS CONT CP	SCC 00	0	18F
Product	Qty	CPC	Title	CIL	REL	
NT9X86AB		B0240643	DPMC SNSE60 CP	9	4	
-A0344793	1	A0344793	IC FTTL SHIFT REG 8-BIT S-P (SM)			
-A0344797	5	A0344797	IC FTTL QUAD FF D (SM)			
-A0345721	3	A0345721	IC FTTL QUAD XOR (SM)			
-A0346030	3	A0346030	IC FTTL QUAD XCVR 3S (SM)			
-A0353008	4	A0353008	IC FTTL QUAD MUX 2 - 1 3S (SM)			
-A0353424	2	A0353424	IC ALSTTL DUAL FF D 4-BIT (SM)			
-CA07X6C100M050T	3	A0337004	CAP AL SMD 10.0UF 20.0% 50V 105C 6.80MM SIZE			
-CHC1206C0G180J5B	1	A0344750	CAP CER CHIP 18.0PF 5.00% 50.0V C0G 1206			
-CHC1206C0G331J1B	8	A0351440	CAP, CERAMIC CHIP, 330PF, 100V, 5%, 1206 SIZE, NIC			
-CHC1206X7R102K5B	1	A0344870	CAP CER CHIP 1.0NF 10.00% 50.0V X7R 1206			
-CHC1206X7R104K5B	122	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206			
-CHC1206X7R473J5B	65	A0329043	CAP CER CHIP 47.0NF 5.00% 50.0V X7R 1206			
-CHR01A1001	2	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A1212	1	A0292424	RES FILM SMT 12.10 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A1500	8	A0326936	RES FILM SMT 150.00 OHM 0.125W 1.00% 100 PPM/C			
-CHR01A1501	1	A0323939	RES FILM SMT 1.50 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A2000	16	A0293770	RES FILM SMT 200.00 OHM 0.125W 1.00% 100 PPM/C			
-CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F			
-CTS10Y2312T100K10	1	A0328922	CAP TAN CHIP 10UF 10V 10% (SM)			
-NT9V86AB	1	B0240582	DPMC SNSE60 CP FW	4	3	
--A0344971	1	A0344971	IC CMOS UV EPROM 8K X 8 45NS			
--QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16			
--QMPAL22V10BP5	15	A0346776	MC			
--QMPAL22V10BP503RKL	1	A0632467	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKM	1	A0632468	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKN	1	A0632469	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKP	1	A0632470	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKQ	1	A0632471	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKR	1	A0632472	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKS	1	A0632473	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKT	1	A0632475	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKU	1	A0632476	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKV	1	A0632477	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKW	1	A0632478	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKX	1	A0632479	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKY	1	A0632480	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RKZ	1	A0632481	PROGRAMMED DEVICE (NT9X86AB)		1	
--QMPAL22V10BP503RLA	1	A0632482	PROGRAMMED DEVICE (NT9X86AB)		1	
--TT03KQE	1	A0409720	PROGRAMMED DEVICE		1	
--TT03KQF	1	A0616426	PROGRAMMED DEVICE		1	
-NT9X8602	1	P0749721	DPMC SNSE60 PCB	1	8	
-NTH294AA	1	A0340417	NTH294AA			
-P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI			
-P0668561	2	P0668561	KEY OCTAGON FOR A0324156			
-P0668764	2	P0668764	FRONT LATCH			

-P0668766	1	P0668766	FRONT FACEPLATE			
-P0675738	1	P0675738	LOGIC CARD CENTER LABEL	2	0	
-P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI			
-P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH			
-P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH			
-P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0	
-P0719254	2	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688			
-P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER	5	0	
-QD-BZX84C3V3	1	A0322396	DIO ZENER 3.3V 0.3W SURFACE			
-QD-MBRS340	1	A0600797	DIODE SCHOTTKY 40V 3A SMD			
-QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO			
-QM100DLP5	2	A0262491	IC DELAY LINE DIGITAL 5 EQUAL TAPS 20 TO 100 NS			
-QM29C821H5	24	A0353814	MC			
-QM50DLP5	3	A0276161	IC DELAY LINE DIGITAL 5 EQUAL TAPS 10 TO 50 NS			
-QM6289-25T5	22	A0345840	MEMORY IC, CMOS SRAM, 16KX4, 25NS, SOJ24, WITH OUT			
-QM74ACTQ245H5	4	A0370290	IC CMOS ADVANCED QUIET OCTAL BUS XCVR 3S (SM)			
-QM74ALS04H5	5	A0329233	IC ALSTTL HEX INV (SM)			
-QM74ALS08H5	1	A0329230	IC ALSTTL QUAD AND (SM)			
-QM74ALS244H5	8	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)			
-QM74ALS245H5	6	A0329224	IC ALSTTL OCTAL BUS XCVR 3S (SM)			
-QM74ALS373H5	5	A0329221	IC ALSTTL OCTAL LATCH D 3S (SM)			
-QM74ALS996H5	13	A0368103	IC ALSTTL LATCH D 8-BIT EDGE-TRIGGER READ/BACK(SM)			
-QM74F00H5	10	A0344991	LOGIC, FAST, QUAD 2-INPUT NAND GATE			
-QM74F02H5	3	A0346033	MC			
-QM74F04H5	13	A0344794	HEX INVERTER			
-QM74F08H5	13	A0344795	MC			
-QM74F10H5	2	A0337023	MC			
-QM74F11H5	1	A0353769	MC			
-QM74F125H5	5	A0345720	MC			
-QM74F138H5	6	A0344821	MC			
-QM74F139H5	5	A0337024	MC			
-QM74F158H5	1	A0353775	MC			
-QM74F161H5	2	A0353002	MC			
-QM74F163H5	1	A0344798	MC			
-QM74F174H5	1	A0345069	MC			
-QM74F20H5	3	A0345060	MC			
-QM74F240H5	1	A0326315	IC FTTL OCTAL BUFF INV 3S (SM)			
-QM74F244H5	7	A0344819	IC, FTTL, OCTAL DRIVER			
-QM74F253H5	2	A0346783	MC			
-QM74F27H5	2	A0353771	IC, LOGIC			
-QM74F280BH5	13	A0367510	IC FTTL PARITY GENERATOR 9-BIT (SM)			
-QM74F30H5	4	A0353776	MC			
-QM74F32H5	12	A0344796	MC			
-QM74F373H5	9	A0344820	MC			
-QM74F374H5	7	A0344990	MC			
-QM74F38H5	2	A0329260	IC FTTL QUAD NAND BUFF OC (SM)			
-QM74F521H5	2	A0345095	MC			
-QM74F543H5	3	A0329256	IC FTTL OCTAL BUS XCVR 3S (SM)			
-QM74F74H5	26	A0322324	IC FTTL DUAL FF D (SM)			
-QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)			
-QMV317BY1	1	A0369657	IC CUSTOM MULTIPLE PORT LINK HANDLER 155-PGA			
-QMV318AY1	1	A0346702	MC			
-QT-MMBT2369	1	A0320800	TRANSISTOR NPN 15VCE 0.2A SMD			
-RNS01W16B102G	6	A0343271	RES NET SMT 1.0 KOHM 0.08W 2.0% 15 RES 16 PINS			
-RNS01W16B103G	1	A0345073	RES NET SMT 10.0 KOHM 0.08W 2.0% 15 RES 16 PINS			
-RNS01W16B472G	9	A0363741	RES NET SMT 4.7 KOHM 0.08W 2.0% 15 RES 16 PINS			
-SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION			
-SCT01B324	15	A0323911	SOCKET DIP 24 POSITION,RIGID INSULATION			
-SCT01B624	1	A0285524	SOCKET DIP 24 POSITION,RIGID INSULATION			
-SIC13A155	2	A0368810	SOCKET PGA 155 POSITION,REMOVABLE INSULATION			
NTZZ01SP	1	B0248593	SN/SNSE BRISC SR70EM CPU	SCC 00	0	19F
Product	Qty	CPC	Title	CIL	REL	
NTZZ01SP		B0248593	SNODE/SNSE BRISC 70 CPU	1	1	
-NT9X10CA	2	B0247320	60MHZ 88110 BRISC 512MB CPU CIRCUIT PACK	7	8	
--A0786229	2	A0786229	NT9X10 SHOCHWATCH DEVICE MANUFACTURER: MEDIA RECOV			
--CHC1206C0G470J5B	1	A0336039	CAP CER CHIP 47.0PF 5.00% 50.0V C0G 1206			
--CHC1206C0G6R8C5B	1	A0352350	CAP, CERAMIC CHIP, 6.8PF, 50V, +-0.25PF, C0G, 1206			
--CHC1206X7R102J5B	6	A0381374	CAP, CER, CHIP, 1.0NF, 5%, 50V, X7R, 1206, NICKEL			
--CHC1206X7R103J5B	14	A0381376	CAP CER CHIP 10.0NF 5.00% 50.0V X7R 1206 NICKEL			
--CHC1206X7R104K5B	311	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206			
--CHC1206X7R471K2B	2	A0345033	CAP CER CHIP 470.0PF 10.00% 200.0V X7R 1206			
--CHC1210X7R474K4B	2	A0378454	CAP CER CHIP 470.0NF 10.00% 16.0V X7R 1210 NICKEL			
--CHR01A1000	5	A0312154	RES FILM SMT 100.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A1001	52	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1002	1	A0293769	RES FILM SMT 10.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1004	31	A0324171	RES FILM SMT 1.00 MOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1102	1	A0291519	RES FILM SMT 11.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1212	1	A0292424	RES FILM SMT 12.10 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1502	1	A0291517	RES FILM SMT 15.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A2210	8	A0312162	RES FILM SMT 221.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A2211	4	A0310848	RES FILM SMT 2.21 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A22R1	62	A0326631	RES FILM SMT 22.10 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A2672	1	A0322763	RES FILM SMT 26.70 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A3320	8	A0319398	RES FILM SMT 332.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A33R2	16	A0329369	RES FILM SMT 33.20 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A43R2	7	A0325311	RES FILM SMT 43.20 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A4750	1	A0312158	RES FILM SMT 475.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A4751	171	A0315266	RES FILM SMT 4.75 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A4752	1	A0326635	RES FILM SMT 47.50 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A47R5	6	A0329542	RES FILM SMT 47.50 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A5110	4	A0315268	RES FILM SMT 511.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR05A1000	1	A0314618	RES FILM SMT 100.00 OHM 0.125W 5.00% 200 PPM/C			
--CHR05A2000	3	A0296779	RES FILM SMT 200.00 OHM 0.125W 5.00% 200 PPM/C			
--CHR11A0000	5	A0296797	RES FILM SMT 0.0 OHM (JUMPER) 2 AMP MAX			
--CHRL01A4R75	10	A0377693	RES FILM SMT 4.75 OHM 0.125W 1.00% 300 PPM/C			
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F			
--CTS10Y1206T2R2K10H	2	A0789538	CAP TAN CHIP 2.2UF 10.00% 10.0V 85C 1206			
--CTS10Y2917T220K16	20	A0329886	CAP TAN CHIP 22UF 16V 10% (SM)			
--CTS10Y2917T470K16	2	A0621792	CAP TAN CHIP 47.0UF 10.00% 16.0V 85C 2917			
--FUS46B20	1	A0623489	FUSE AX FAST 20.000A 250VAC 3AB			
--MMC016MX40WP-60	8	A0665301	MEMORY MODULE, CMOS DRAM, 16MX40, 60NS, WIDE DIL89			
--NT9V10CA	1	B0247322	60MHZ 88110 BRISC 512MB CPU FIRMWARE	1	1	
---QM68HC711KA4-5T5	1	A0630642	8-BIT, 5 MHZ MICROCONTROLLER, OTP (0-70C)			
---QM68HC711KA4-5T503RL	1	A0665918	PROGRAMMED DEVICE FOR NT9V10CA		1	
--NT9X1002	1	P0741381	60 MHZ 88110 BRISC CPU PCB (NT9X1002)	1	6	
--NT9X1020	1	B0242571	BRISC PROCESSOR	1	1	
---QM88110-60Y1	1	A0626239	MICROCIRCUIT, 32-BIT/60 MHZ SECOND GENERATION RISC			
---QM88110-60Y1DIP	1	A0630669	DIPPED VERSION OF A0626239			
--P0428540	16	P0428540	SCREW, FLAT FILL HD (SLTD), 0.112-40X0.156, STEEL			
--P0652942	16	P0652942	NUT SELF-CLINCH, (PCB) SS, FIN: 662A, (PENN ENG. K			
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI			
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156			
--P0668764	2	P0668764	FRONT LATCH			
--P0668766	1	P0668766	FRONT FACEPLATE			
--P0691666	4	P0691666	MACH SCR AND WSHR ASSY (SEMS)			
--P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI			
--P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH			
--P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH			
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0	
--P0719254	2	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688			
--P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER	5	0	

--P0802169	3	P0802169	LIGHT PIPE		
--P0802554	1	P0802554	FRONT CARD LED LABEL	2	0
--P0803174	1	P0803174	BRISC HEATSINK	2	0
--P0803176	2	P0803176	CTAB HEATSINK	2	0
--P0803178	1	P0803178	SCIE HEATSINK	2	0
--P0803180	1	P0803180	BRISC SPRING	2	0
--P0803181	3	P0803181	CTAP SPRING	2	0
--P0906744	1	P0906744	NT9X10 CTAB ONE-PIECE HEATSINK CAGE	1	0
--P0906745	1	P0906745	NT9X10 1 PIECE HEATSINK GASKET. VENDOR: WL GORE GO		
--QD-BAS16	2	A0312142	DIODE HIGH-SPEED SWITCH 75VBR 0.2A SMD		
--QD-BAT54	4	A0376085	DIODE, SCHOTTKY, 30V 0.2A SMD		
--QD-BZX84C3V3	1	A0322396	DIO ZENER 3.3V 0.3W SURFACE		
--QD-HSMGTX00	2	A0386234	DIODE, LED, GREEN, SMD		
--QD-HSMSTX00	1	A0386229	DIODE, LED, RED, SMD		
--QM-LM2931H5	1	A0380625	VOLTAGE REGULATOR, LOW DROP-OUT, ADJUSTABLE		
--QM-MPC974-AF5	1	A0659843	3.3/5V PLL CLOCK DRIVER - REV 8 SILICON- IN 52 PIN		
--QM3486H5	1	A0329245	IC INTRFC QUAD RCVR EIA (SM)		
--QM3487H5	1	A0329244	IC INTRFC QUAD DRVR EIA (SM)		
--QM624100X-25T5	20	A0632571	MEMORY IC, CMOS SRAM, 1MX4, 25NS, S0J32, 5V		
--QM74ABT162244H5	11	A0618414	ADV BICMOS, SERIES DAMPED ,16-BIT NON-INVERTING DR		
--QM74ABT162460H5	20	A0619618	DIGITAL LOGIC, BICMOS, SERIES DAMPED, QUAD 4 TO 1,		
--QM74ABT16543H5	7	A0385127	DIGITAL LOGIC, BICMOS, 16-BIT REGISTERED TRANSCEIV		
--QM74ABT2244H5	1	A0618415	ADV BICMOS, 25 OHM SERIES DAMPED , 8-BIT NON-INVER		
--QM74ABT241H5	1	A0385681	ABT LOGIC, OCTAL INVERTING DRIVER WITH TRI-STATE O		
--QM74CBT3244H5	1	A0633977	8-BIT CROSSBAR SWITCH		
--QM74F04H5	8	A0344794	HEX INVERTER		
--QM74F241H5	1	A0353006	IC, FTTL, OCTAL DRIVER		
--QM74LVT244H5	1	A0605087	ADV BICMOS, LVT 3.3V, 8-BIT NON-INVERTING DRIVER W		
--QM85C30-10ET5	1	A0376049	IC CMOS SCC 10MHZ (SM)		
--QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)		
--QMV614CZ5	1	A0635957	B80B1B1 CUSTOM IC, 432 PIN TAB		
--QMV615CZ5	1	A0635958	B81C CUSTOM IC, 432 PIN TAB		
--QMV616BZ5	1	A0627859	B82B1B1-66 CUSTOM IC, 432 PIN TAB		
--QNM1100PST2	2	A0376235	IC CRYSTAL OSCILLATOR 20.000MHZ (SM)		
--QNM1152PSRAT3.6864	1	A0602151	OSC CLOCK 3.686MHZ 100.000PPM		
--QT-MMBT2369	1	A0320800	TRANSISTOR NPN 15VCE 0.2A SMD		
--R0106404	1	R0106404	THERMAL COMPOUND SILICONE FREE SPEC NPS60017, SYNT		
--R0112034	1.5	R0112034	EXTRUSION, HEAT SHRINK TBG POLYOLEFIN-FLEXIBLE BLA		
--RNS01W16B472G	7	A0353741	RES NET SMT 4.7 KOHM 0.06W 2.0% 15 RES 16 PINS		
-NT9X26FA	2	B0247323	BRISC RTIF PADDLE-CARD FOR SERIES 70/512 SNODE	7	4
--A0336785	2	A0336785	IC HCMOS DEMUX 3-TO-8 (SM)		
--A0336788	1	A0336788	IC HCMOS DUAL FF D (SM)		
--A0344705	2	A0344705	IC CMOS SCC 8MHZ (SM)		
--A0346030	1	A0346030	IC FTTL QUAD XCVR 3S (SM)		
--CA07X6C470M016T	1	A0337006	CAP AL SMD 47.0UF 20.0% 16V 105C 6.80MM SIZE		
--CHC0805C0G120J5B	1	A0325265	CAP CER CHIP 12.0PF 5.00% 50.0V C0G 0805		
--CHC0805C0G330J5B	2	A0328974	CAP, CER, CHIP, 33PF, 5%, 50V, C0G, 0805, NICKEL		
--CHC0805C0G471J5B	8	A0325379	CAP CER CHIP 470.0PF 5.00% 50.0V C0G 0805		
--CHC0805X7R103J5B	1	A0322287	CAP CER CHIP 10.0NF 5.00% 50.0V X7R 0805		
--CHC0805X7R104K4B	5	A0378587	CAP CER CHIP 100.0NF 10.00% 16.0V X7R 0805 NICKEL		
--CHC1206X7R104K5B	69	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206		
--CHR01A1000	5	A0312154	RES FILM SMT 100.00 OHM 0.125W 1.00% 100 PPM/C		
--CHR01A1001	10	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1002	6	A0293769	RES FILM SMT 10.00 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1003	6	A0291505	RES FILM SMT 100.00 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1004	5	A0324171	RES FILM SMT 1.00 MOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1102	2	A0291519	RES FILM SMT 11.00 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1211	6	A0292434	RES FILM SMT 1.21 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1212	6	A0292424	RES FILM SMT 12.10 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1502	1	A0291517	RES FILM SMT 15.00 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A1780	3	A0315294	RES FILM SMT 178.00 OHM 0.125W 1.00% 100 PPM/C		
--CHR01A2211	9	A0310848	RES FILM SMT 2.21 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A2432	1	A0368323	RES FILM SMT 24.30 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A3011	2	A0322782	RES FILM SMT 3.01 KOHM 0.125W 1.00% 100 PPM/C		
--CHR01A30R1	2	A0325352	RES FILM SMT 30.10 OHM 0.125W 1.00% 100 PPM/C		
--CHR01A3320	3	A0319398	RES FILM SMT 332.00 OHM 0.125W 1.00% 100 PPM/C		
--CHR01A4021	1	A0367887	RES FILM SMT 4.02 KOHM 0.125W 1.00% 100 PPM/C		
--CHR05A1001	2	A0298036	RES FILM SMT 1.00 KOHM 0.125W 5.00% 200 PPM/C		
--CHR05A1003	1	A0291522	RES FILM SMT 100.00 KOHM 0.125W 5.00% 200 PPM/C		
--CHR05A1005	1	A0315355	RES FILM SMT 10.00 MOHM 0.250W 5.00% 200 PPM/C		
--CHR05A1601	1	A0291523	RES FILM SMT 1.60 KOHM 0.125W 5.00% 200 PPM/C		
--CHR11A0000	7	A0296797	RES FILM SMT 0.0 OHM (JUMPER) 2 AMP MAX		
--CRP04P25ZS2450GBL	2	A0645792	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE RT PCB FP		
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F		
--FUS45X5.0	1	A0378482	FUSE, FAST, SMD, 5.0A, 125VAC/DC, MOLDED, 2917 SIZ		
-NT9V26FA	1	B0247324	BRISC RTIF PADDLE-CARD F/W FOR SERIES 70/512 SNODE	2	2
---QM27C256-20T5	1	A0368853	MEMORY IC, CMOS OTPROM, 32KX8, 200NS, PLCC32		
---QM27C256-20T503RUR	1	A0665924	PROGRAMMED DEVICE FOR NT9V26EA		1
---QM28F020-150T5	4	A0352458	MEMORY IC, CMOS FLASH EPROM, 256K X 8, 150NS, PLCC		
---QM28F020-150T503RUL	1	A0665919	PROGRAMMED DEVICE FOR NT9V26EA		1
---QM28F020-150T503RUM	1	A0665920	PROGRAMMED DEVICE FOR NT9V26EA		1
---QM28F020-150T503RUN	1	A0665921	PROGRAMMED DEVICE FOR NT9V26EA		1
---QM28F020-150T503RUP	1	A0665922	PROGRAMMED DEVICE FOR NT9V26EA		1
---QM28SCID04-90CH5	1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION		
---QM28SCID04-90CH503SB	1	A0783764	PROGRAMMED DEVICE FOR NT9V26GA		1
---QMPALCE22V10H-15CP5	1	A0367232	IC CMOS PAL 15NS		
---QMPALCE22V10H-15CP5	1	A0665923	PROGRAMMED DEVICE FOR NT9V26EA	R	1
UQ					
-NT9X2605	1	P0738758	BRISC RTIF CIRCUIT PCB (NT9X2605)	6	9
--P0183093	4	P0183093	LOCK WASHER		
--P0298849	4	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
--P0552373	2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR		
--P0668559	2	P0668559	4X90 MOUNTING BLOCK		
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156		
--P0668769	2	P0668769	INSERTION AID		
--P0675237	1	P0675237	FACEPLATE		
--P0676546	1	P0676546	REAR LATCH		
--P0676696	1	P0676696	REAR UPPER LATCH		
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0
--P0703915	4	P0703915	DSUB BECU FINGER GASKET	2	0
--P0714987	1	P0714987	HSI SHEAR PLATE	2	1
--P0719254	6	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.588		
--P0802555	1	P0802555	REAR CARD LED LABEL	2	0
--QB-PG504	1	A0314399	PWR CONV PCB MOUNT DCDC 1W		
--QD-BAS16	3	A0312142	DIODE HIGH-SPEED SWITCH 75VBR 0.2A SMD		
--QD-BZX84C11	1	A0369660	DIO ZENER 11V 0.3W SURFACE		
--QD-BZX84C15	2	A0298506	DIO ZENER 15V 0.3W SURFACE		
--QD-BZX84C4V7	3	A0344763	DIO ZENER 4.7V 0.3W SURFACE		
--QD-BZX84C8V2	1	A0346004	DIO ZENER 8.2V 0.3W SURFACE		
--QD-HLMP1301A	1	A0361553	DIODE LED RED RT ANG T-1 CASE		
--QD-HLMP1523A	2	A0361552	DIODE LED GREEN RT ANG T-1 CASE		
--QD-LP5818	1	A0329326	DIO SCHOTTKY 30V 1A SURFACE		
--QM28C64-25T5	1	A0353871	MEMORY IC, CMOS EEPROM, 8KX8, 250NS, PLCC32		
--QM3486H5	2	A0329245	IC INTRFC QUAD RCVR EIA (SM)		
--QM3487H5	2	A0329244	IC INTRFC QUAD DRVR EIA (SM)		
--QM393H5	2	A0317192	IC LINEAR COMPTR (SM)		
--QM62256L-10H5	1	A0353872	MEMORY IC, CMOS SRAM, 32KX8, 100NS, SOP28(330 MIL)		
--QM74ACT74H5	1	A0353888	MC		
--QM74ALS00H5	1	A0329229	IC ALSTTL QUAD NAND (SM)		
--QM74ALS04H5	2	A0329233	IC ALSTTL HEX INV (SM)		

--QM74ALS11H5	1	A0346787	MC			
--QM74ALS175H5	1	A0353015	MC			
--QM74ALS20H5	1	A0329234	IC ALSTTL DUAL NAND 4-IN (SM)			
--QM74ALS244H5	2	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)			
--QM74ALS253H5	1	A0353019	MC			
--QM74ALS373H5	1	A0329221	IC ALSTTL OCTAL LATCH D 3S (SM)			
--QM74ALS38H5	2	A0329527	MC			
--QM74F00H5	3	A0344991	LOGIC, FAST, QUAD 2-INPUT NAND GATE			
--QM74F08H5	1	A0344795	MC			
--QM74F125H5	1	A0345720	MC			
--QM74F14H5	1	A0353777	MC			
--QM74F240H5	2	A0325315	IC FTTL OCTAL BUFF INV 3S (SM)			
--QM74F244H5	2	A0344819	IC, FTTL, OCTAL DRIVER			
--QM74F280H5	4	A0346029	MC			
--QM74F32H5	1	A0344796	MC			
--QM74F373H5	3	A0344820	MC			
--QM74F521H5	2	A0345095	MC			
--QM74F657H5	4	A0353852	FTTL, OCTAL BIDIRECTIONAL TRANSCEIVER WITH PARITY			
--QM74F74H5	2	A0322324	IC FTTL DUAL FF D (SM)			
--QM74HC595H5	2	A0361648	IC HCMOS SHIFT REG 8-BIT 3S (SM)			
--QM74HCT00H5	1	A0368432	IC HCMOS QUAD NAND (SM)			
--QM74HCT139H5	1	A0369054	IC HCMOS DUAL DEMUX 2 - 4 (SM)			
--QM74HCT393H5	2	A0368278	IC HCMOS DUAL BIN COUNTER (SM)			
--QM74HCT4040H5	2	A0361948	IC HCMOS CNTR BIN 12-STAGE (SM)			
--QM75C188H5	1	A0337008	MC			
--QM75C189AH5	1	A0337007	MC			
--QM80C31T5	1	A0329243	IC CMOS UP 8-BIT ROMLESS (SM)			
--QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)			
--QNM1152PSRAT22.1184	1	A0385832	CRYSTAL CLOCK OSCILLATOR, 22.1184 MHZ, TTL, +-100			
--QTW51A	2	A0291863	TRANSISTOR PNP 300V 0.2A SMD			
--QTW53A	1	A0292811	TRANSISTOR NPN 300VCE 0.2A SMD			
--RNS01W16B102G	2	A0343271	RES NET SMT 1.0 KOHM 0.08W 2.0% 15 RES 16 PINS			
--RNS01W16B103G	7	A0345073	RES NET SMT 10.0 KOHM 0.08W 2.0% 15 RES 16 PINS			
--SCT09B32	5	A0354741	SOCKET PLCC 32 POSITION,RIGID INSULATION			
-P0865776	2	P0865776	DESIGN LABEL FOR NT9X10CA	1	0	
-P0865777	2	P0865777	DESIGN LABEL FOR NT9X26FA	1	0	
NT9X86AB (see previous)	1	B0240543	DUAL PORT MESS CONT CP	SCC 00	0	21F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	23F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	23F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	24F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	24F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	25F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	25F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	26F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	26F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	0	27F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	0	27F
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	8R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	8R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	9R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	9R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	10R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	10R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	11R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	11R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	13R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	13R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	14R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	14R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	15R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	15R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	16R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	16R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	23R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	23R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	24R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	24R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	25R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	25R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	26R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	26R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	29R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	29R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	30R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	30R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	31R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	31R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	0	32R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	0	32R
NTZZ34FB	1	B0246094	DMS S-NODE SE ENET SHELF	SCC 00	13	
ENGINEERING CODE	QTY.	CPC-CODE	DESCRIPTION/			
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NT9X36BA	2.00	B0227556	ENET+ CLOCK & MESSAGE CP			
NT9X35FA	4.00	B0231231	4K X 8K CROSS-POINT CP			
NT9X19BA	2.00	B0221846	FILLER PADDLEBOARD CP			
NT9X40BB	2.00	B0234418	QUAD DS512 FIBER			
			INTERFACE PADDLE BOARD			
NT9X45BA	2.00	B0231590	ENET DS512/DS30 INTERFACE			
			PADDLE BOARD CP			
NPS90558-06L06	8.00	A0352269	LENGTH = 1.9 METERS,			
			MULTIMODE, 62.5/125 UM,			
			ST-ST			
P0704531	2.00	P0704531	FRONT & REAR SHELF			
			PACKFILL LABELS			
P0735098	4.00	P0735098	DESIGN LABEL (NT9X35FA)			
P0709516	2.00	P0709516	DESIGN LABEL (NT9X19BA)			
P0734155	2.00	P0734155	DESIGN LABEL (NT9X40BB)			
P0731527	2.00	P0731527	DESIGN LABEL (NT9X45BA)			
NTZZ34PC	1	B0245907	GLOBAL -5V PWR CONVERTER	SCC 00	13	1F
Product	Qty	CPC	Title	CIL	REL	
NTZZ34PC		B0245907	GLOBAL -5V POWER CONVERTER (48V/60V)	1	1	
-NT9X31AB	2	B0235799	GLOBAL +5V, 20A POWER CONVERTER CP, -39.5V VIN(MIN	14	6	
--A0252936	3	A0252936	DIODE SWITCH .2A 75V			
--A0253336	3	A0253336	RES FILM 10 KOHM 1/4W 1%			
--CA05P681V100SP	1	A0328562	CAP AL RA 680UF 100V +100-50%			
--CA10Z220M100SXA	7	A0636546	CAP AL RL 22.0UF 20% 100.0V 105C 5.0MM SPAN			
--CA11Z472W7R5S	2	A0298716	CAP AL RA 4700UF 7.5V +100-10%			
--CA13Z101M040SXE	3	A0368890	CAP AL RL 100.0UF 20% 40.0V 105C 5.0MM SPAN			
--CB11X7RE105K	5	A0261756	CAP CER RA 1UF 50V 10%			
--CB17X7RA103J	2	A0271560	CAP CER AX 0.01UF 50V 5%			
--CB17X7RA472K	1	A0252341	CAP CER AX 4.7NF 50V 10%			
--CB17X7RA561K	2	A0256280	CAP CER AX 560PF 50V 10%			
--CB17X7RD104K	11	A0328980	CAP CER AX 100.0NF 10.0% 50.0V X7R 5.080MM LONG			
--CB17Z5UB474Z	1	A0271556	CAP CER AX 0.47UF 50V			
--CB18X7RA103K	1	A0259459	CAP CER AX 0.01UF 100V 10%			
--CB18X7RB104K	11	A0252195	CAP CER AX 0.1UF 100V 10%			
--CB19C0GA101J	1	A0248729	CAP CER AX 100PF 50V 5%			
--CB19C0GA221J	1	A0264285	CAP CER AX 220PF 50V 5%			
--CB19C0GB102F	2	A0264801	CAP CER AX 1 NF 50V 1%			
--CB19C0GB222J	1	A0254533	CAP CER AX 2.2NF 50V 5%			
--CP01Y153K400	1	A0382034	CAP, POLYPRO, AX, 15NF, 10%, 400V			

Product	Qty	CPC	Title	OL	REL	
--CP01Y222K400	1	A0258354	CAP PP AX 2.2NF 400V 10%			
--CPP02A04B04	2	A0292825	CONN STR HEADER 1X4 ARRAY 0.100 PITCH AUPD STR PCB			
--CR03X104M250C	4	A0346063	CAP EMI RA 100.00NF 20.000% 275.0V 100C 15.0MM SPA			
--CTP19P48ZNS6	2	A0319276	CONN RT HEADER, P, DIN 3X16 ARRAY 0.200 PITCH AU M			
--NPS25028L2C	2	A0264710	CONN PCB TEST N/A ARRAY 0.400 PITCH AU FEMALE RT P			
--NPS50024L30	1	A0329721	HEATSINK			
--NT9V31AB	1	B0235800	GLOBAL +5V, 20A POWER CONVERTER FIRMWARE	1	1	
---QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16			
---TT03JRY	1	A0396114	PROGRAMMED DEVICE		1	
--NT9X3101	1	P0661407	PCB FOR NT9X31AA	6	6	
--NTT441AU	1	A0383523	FLYBACK TRANSFORMER			
--P0116654	2	P0116654	MACHINE SCREW MACH SCR S PAN HEAD SLO			
--P0125084	2	P0125084	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.125-40			
--P0183093	6	P0183093	LOCK WASHER			
--P0247375	1	P0247375	NUT,HEX,MACHINE SCREW, 0.112-40			
--P0284133	2	P0284133	WASHER, NOMINAL #2, STEEL, 289A			
--P0297882	7	P0297882	RIVET,MATL CODE=S 289A FNSH,DIA=0.123,0.188 LG			
--P0298848	6	P0298848	MACHINE SCREW MACH SCR S PAN HEAD SLO			
--P0298849	6	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56			
--P0356522	2	P0356522	WSR LOCK INT TOOTH 0.141-0.295 X 0.022			
--P0387666	7	P0387666	LOCK WASHER			
--P0428394	2	P0428394	CAP SCREW			
--P0594488	3	P0594488	SHOULDER WASHER			
--P0613408	9	P0613408	PLASTITE 60-1, 0.123-20X0.312, HEX WSHR HD, STEEL,			
--P0661459	5	P0661459	SCREW MACH. (HEX WASHER SCREW, HEX WSHR HEAD (N			
--P0667456	1	P0667456	STIFFENING BRACKET NT9X31AA			
--P0667988	2	P0667988	TENSION WASHER			
--P0668764	2	P0668764	FRONT LATCH			
--P0669000	1	P0669000	POWER FACEPLATE			
--P0669003	9	P0669003	GASKET HOLDER			
--P0672364	1	P0672364	LIGHT PIPE			
--P0675705	1	P0675705	-5V POWER SUPPLY LABEL			
--P0676196	2	P0676196	KNURLED HEADER PIN			
--P0691877	4	P0691877	SHOULDER WASHER			
--P0692047	1	P0692047	SEMI-CONDUCTOR INSULATOR, BERGQUIST CO PPK4-61			
--P0697673	9	P0697673	EMI FINGER GASKET (POWER PACK)			
--P0851011	2	P0851011	HEATSINK 2 U/O NT2X70	4	0	
--P0880779	2	P0880779	SILPAD			
--P0934197	1	P0934197	C-UR-US LABEL	1	0	
--QD-1N4004	3	A0243582	DIODE RECTIFIER 400V 1A			
--QD-1N4937	7	A0258779	DIODE FAST RECOVERY 600V 1A			
--QD-1N5231B	2	A0260857	DIODE ZENER <1W 5.1V			
--QD-1N5245B	1	A0273067	DIODE ZENER <1W 15V			
--QD-1N5248B	2	A0292564	DIODE ZENER 18V .5MW			
--QD-1N5417	2	A0261353	DIODE RECT FAST RECOVERY 3A 200V			
--QD-550-2406	1	A0297222	DIODE, LED, RED, RT-ANG			
--QDK84D	1	A0353482	DIODE RECTIFIER DUAL SCHOTTKY 40V 45A			
--QFF4A5	1	A0259505	FUSE, FAST, AX, 3A, 125V, PICO			
--QHP148B	1	A0244563	INDR POWER INDUCTOR THRU-HOLE 79.500 UH			
--QHP197A2	1	A0290166	INDR POWER INDUCTOR THRU-HOLE 1.000 UH			
--QHP256A1	1	A0316000	INDR POWER THRU-HOLE 4000.000 UH			
--QM393E5	2	A0273294	MICROCIRCUIT, LINEAR COMPARATOR			
--QM431-1CZ5	3	A0312039	IC LINEAR VOLTAGE REFERENCE			
--QM4N37E5	1	A0263562	OPTICAL COUPLER			
--QMMOC3010E5	1	A0382718	OPTOCOUPLER IC, TRIAC O/P			
--QMUC2845E5	2	A0353096	MC			
--QT-BS107	2	A0325326	TRANSISTOR MOSFET N-CH 200VDS 0.25A			
--QT-IRF540	1	A0314857	TRANSISTOR, MOSFET, N-CH, 100VDS 27A 0.085OHMS			
--QT-IRF640	1	A0296790	TRANSISTOR, MOSFET, N-CH, 200VDS 18A 0.18OHMS			
--QT-IRFP250	1	A0354743	TRANSISTOR MOSFET N-CH 200VDS 30A 0.085OHM			
--QT-PN2222A	2	A0264620	XSTR NPN SMALL SIGNAL GENERAL 40V 0.6A THRU-HOLE			
--QT-PN2907A	3	A0272995	TRANSISTOR PNP SMALL SIGNAL 60VCE 0.6A			
--QTK278A10	1	A0293585	XFORMER DRVR			
--QTK278A12	1	A0296302	XFORMER DRVR			
--QTK281A29	1	A0758985	XFMR POWER CONVERTER THRU-HOLE 1 OUTPUTS			
--QV-V100ZA15	1	A0279964	VARISTOR SUR SUPP			
--RB14H2C24	2	A0287523	RELAY FS FORM 2C 24V			
--RF06BW1000F	3	A0271689	RES FILM 100.00 OHMS .250W 1.0%			
--RF06BW1001F	9	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW10R0F	2	A0264277	RES FILM 10.00 OHMS .250W 1.0%			
--RF06BW1501F	1	A0255782	RES, FILM, 1500.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1502F	2	A0253457	RES, FILM, 15000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1503F	1	A0259310	RES, FILM, 150000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW1582F	1	A0271772	RES FILM 15800.00 OHMS .250W 1.0%			
--RF06BW1622F	1	A0271779	RES FILM 16200.00 OHMS .250W 1.0%			
--RF06BW1871F	1	A0259306	RES, FILM, 1870.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW2000F	1	A0265137	RES FILM 200.00 OHMS .250W 1.0%			
--RF06BW2001F	2	A0270348	RES FILM 2000.00 OHMS .250W 1.0%			
--RF06BW2002F	4	A0255548	RES, FILM, 20000.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW20R0F	2	A0271819	RES FILM 20.00 OHMS .250W 1.0%			
--RF06BW2210F	1	A0266442	RES FILM 221.00 OHMS .250W 1.0%			
--RF06BW2371F	1	A0259311	RES, FILM, 2370.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW2491F	1	A0271856	RES FILM 2490.00 OHMS .250W 1.0%			
--RF06BW2552F	1	A0253459	RES, FILM, 25500.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW2742F	1	A0263178	RES FILM 27400.00 OHMS .250W 1.0%			
--RF06BW2802F	1	A0261793	RES FILM 28000.00 OHMS .250W 1.0%			
--RF06BW3011F	7	A0253460	RES, FILM, 3010.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW3091F	1	A0271889	RES FILM 3090.00 OHMS .250W 1.0%			
--RF06BW30R1F	1	A0263083	RES FILM 30.100 OHMS .250W 1.0%			
--RF06BW3321F	1	A0258293	RES, FILM, 3320.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW3322F	1	A0255550	RES, FILM, 33200.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW3571F	2	A0263018	RES FILM 3570.00 OHMS .250W 1.0%			
--RF06BW3922F	1	A0264746	RES FILM 39200.00 OHMS .250W 1.0%			
--RF06BW4321F	1	A0271938	RES FILM 4320.00 OHMS .250W 1.0%			
--RF06BW4322F	1	A0271939	RES FILM 43200.00 OHMS .250W 1.0%			
--RF06BW5110F	4	A0263182	RES FILM 511.00 OHMS .250W 1.0%			
--RF06BW5111F	2	A0257178	RES, FILM, 5110.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW5113F	1	A0271982	RES FILM 511000.00 OHMS .250W 1.0%			
--RF06BW51R1F	2	A0271976	RES FILM 51.100 OHMS .250W 1.0%			
--RF06BW5622F	1	A0272001	RES FILM 56200.00 OHMS .250W 1.0%			
--RF06BW6192F	1	A0272008	RES FILM 61900.00 OHMS .250W 1.0%			
--RF06BW6811F	1	A0258691	RES, FILM, 6810.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW7500F	1	A0253337	RES, FILM, 750.000 OHMS .250 POWER, 1.00 TOL			
--RF06BW75R0F	1	A0272035	RES FILM 75.00 OHMS .250W 1.0%			
--RF08BW10R0F	1	A0267198	RES FILM 10.00 OHMS .500W 1.0%			
--RF08BW1R00F	1	A0272199	RES FILM AX 1.0 OHM 0.50W 1.0% 100 PPM/C			
--RF08BW2002F	1	A0273457	RES FILM 20000.00 OHMS .500W 1.0%			
--RF08BW2212F	1	A0273473	RES FILM AX 22.1 KOHM 0.50W 1.0% 100 PPM/C			
--RF08BW2672F	2	A0273512	RES FILM 26700.00 OHMS .500W 1.0%			
--RF08BW3922F	2	A0273597	RES FILM AX 39.2 KOHM 0.50W 1.0% 100 PPM/C			
--RF14BX4301G	1	A0264251	RES FILM 4300.00 OHMS 2.00W 2.0%			
--RF14BX5601G	2	A0257166	RES, FILM, 5600.000 OHMS 2.000 POWER, 2.00 TOL			
--RF16BX15R0G	2	A0271116	RES FILM 15.00 OHMS 3.00W 2.0%			
--RF16BX2431F	1	A0237955	RES, FILM, 2430.000 OHMS 3.000 POWER, 1.00 TOL			
--RF16BX68R0G	1	A0264783	RES FILM AX 68.0 OHM 3.00W 2.0% 200 PPM/C			
--RSP05H2C05S1	2	A0329836	RELAY FS 2 FORM C 5V			
--SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION			
--SPC27C9R5PBS	1	A0382064	SW ROCKER 2PDT (ON)-ON-(ON) RT PC TERM			
--TP01BZ200P060	2	A0274859	THERMISTOR, 20.00 OHMS, TOL= 30.0 SIZE= .550X.100			
NTZZ34PA	1	B0245906	GLOBAL +5V PWR CONVERTER	SCC 00	13	4F

NTZZ34PA		B0245906	GLOBAL +5V POWER CONVERTER (48V/60V)	1	1
-NT9X30AB	2	B0228880	GOLABL +5V, 86A POWER CONVERTER CP, -39.5V VIN/MIN	10	D3
--NT9V30AB	1	B0235798	GLOBAL +5V, 86A POWER CONVERTER FIRMWARE	1	1
---QM6331L-55P5	1	A0322580	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16		
---TT03JRX	1	A0396115	PROGRAMMED DEVICE		1
--NT9X3004	1	B0256722	POWER CONVERTER DAUGHTER BOARD PCP FOR (NT9X30AB)	4	D3
---A0252936	7	A0252936	DIODE SWITCH .2A 75V		
---A0253336	2	A0253336	RES FILM 10 KOHM 1/4W 1%		
---CA10Z220M100SXA	2	A0636546	CAP AL RL 22.0UF 20% 100.0V 105C 5.0MM SPAN		
---CA13Z101M040SXE	2	A0368890	CAP AL RL 100.0UF 20% 40.0V 105C 5.0MM SPAN		
---CB17X7RA103K	1	A0248717	CAP CER AX 0.01UF 50V 10%		
---CB17X7RA223K	2	A0259403	CAP CER AX 0.022UF 50V 10%		
---CB17X7RA331K	2	A0252338	CAP CER AX 330PF 50V 10%		
---CB17X7RA561K	1	A0256280	CAP CER AX 560PF 50V 10%		
---CB17X7RB224J	1	A0361753	CAP CER AX 220.0NF 5.0% 50.0V X7R 7.370MM LONG		
---CB17X7RD104K	15	A0328980	CAP CER AX 100.0NF 10.0% 50.0V X7R 5.080MM LONG		
---CB17Z5UB474M	2	A0257223	CAP CER AX 470.0NF 20.0% 50.0V Z5U 7.370MM LONG		
---CB19C0GA101J	3	A0248729	CAP CER AX 100PF 50V 5%		
---CB19C0GA221J	2	A0264285	CAP CER AX 220PF 50V 5%		
---CB19C0GA471J	1	A0248721	CAP CER AX 470PF 50V 5%		
---CB19C0GB102F	3	A0264801	CAP CER AX 1 NF 50V 1%		
---CBR34B20E	1	A0644539	CONN SIDE ENTRY 2X10 ARRAY 0.100 PITCH AU FEMALE R		
---CBR35B004	2	A0370220	CONN SIDE ENTRY 1X4 ARRAY 0.100 PITCH AU FEMALE RT		
---CP01Y222K400	1	A0258354	CAP PP AX 2.2NF 400V 10%		
---NT9X3008	1	P0914045	POWER CONVERTER DAUGHTERCARD PCB	3	2
---NTT441AU	1	A0383523	FLYBACK TRANSFORMER		
---P0297882	2	P0297882	RIVET,MATL CODE=S 289A FNSH,DIA=0.123,0.188 LG		
---P0913546	2	P0913546	BRACKET		
---QD-1N4004	2	A0243582	DIODE RECTIFIER 400V 1A		
---QD-1N4937	3	A0258779	DIODE FAST RECOVERY 600V 1A		
---QM2846P5	1	A0328269	IC LINEAR SWITCH MODE PS CONT		
---QM393E5	3	A0273294	MICROCIRCUIT, LINEAR COMPARATOR		
---QM431-1CZ5	1	A0312039	IC LINEAR VOLTAGE REFERENCE		
---QMUC2845E5	1	A0353096	MC		
---QT-IRF640	1	A0296790	TRANSISTOR, MOSFET, N-CH, 200VDS 18A 0.18OHMS		
---QT-MPSA56	1	A0275941	XSTR PNP SMALL SIGNAL GENERAL 80V 0.5A THRU-HOLE		
---QT-PN2222A	3	A0264620	XSTR NPN SMALL SIGNAL GENERAL 40V 0.6A THRU-HOLE		
---RF06BW1001F	1	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW10R0F	1	A0264277	RES FILM 10.00 OHMS .250W 1.0%		
---RF06BW1101F	1	A0271706	RES FILM 1100.00 OHMS .250W 1.0%		
---RF06BW1182F	1	A0270325	RES FILM 11800.00 OHMS .250W 1.0%		
---RF06BW1432F	1	A0266445	RES FILM 14300.00 OHMS .250W 1.0%		
---RF06BW1501F	2	A0255782	RES, FILM, 1500.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW1502F	1	A0253457	RES, FILM, 15000.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW1503F	1	A0259310	RES, FILM, 150000.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW1582F	1	A0271772	RES FILM 15800.00 OHMS .250W 1.0%		
---RF06BW1621F	1	A0259305	RES, FILM, 1620.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW1782F	1	A0261670	RES FILM 17800.00 OHMS .250W 1.0%		
---RF06BW2001F	1	A0270348	RES FILM 2000.00 OHMS .250W 1.0%		
---RF06BW2002F	1	A0255548	RES, FILM, 20000.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW2152F	1	A0261792	RES FILM 21500.00 OHMS .250W 1.0%		
---RF06BW2210F	1	A0266442	RES FILM 221.00 OHMS .250W 1.0%		
---RF06BW2552F	1	A0253459	RES, FILM, 25500.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW2672F	1	A0258767	RES, FILM, 26700.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW2741F	1	A0259312	RES, FILM, 2740.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW2742F	1	A0263178	RES FILM 27400.00 OHMS .250W 1.0%		
---RF06BW3011F	12	A0253460	RES, FILM, 3010.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW3571F	1	A0263018	RES FILM 3570.00 OHMS .250W 1.0%		
---RF06BW4321F	1	A0271936	RES FILM 4320.00 OHMS .250W 1.0%		
---RF06BW4532F	1	A0258296	RES, FILM, 45300.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW4752F	2	A0258298	RES, FILM, 47500.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW5110F	3	A0263182	RES FILM 511.00 OHMS .250W 1.0%		
---RF06BW5112F	1	A0253436	RES, FILM, 51100.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW5113F	1	A0271982	RES FILM 511000.00 OHMS .250W 1.0%		
---RF06BW51R1F	2	A0271978	RES FILM 51.100 OHMS .250W 1.0%		
---RF06BW6191F	1	A0258751	RES, FILM, 6190.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW6651F	1	A0272021	RES FILM 6650.00 OHMS .250W 1.0%		
---RF06BW6811F	2	A0258691	RES, FILM, 6810.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW7151F	1	A0272031	RES FILM 7150.00 OHMS .250W 1.0%		
---RF06BW7500F	1	A0253337	RES, FILM, 750.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW8061F	1	A0259323	RES, FILM, 8060.000 OHMS .250 POWER, 1.00 TOL		
---RF06BW8251F	1	A0272058	RES FILM 8250.00 OHMS .250W 1.0%		
---RF08BW1R00F	1	A0272199	RES FILM AX 1.0 OHM 0.50W 1.0% 100 PPM/C		
---RF08BW2672F	1	A0273512	RES FILM 26700.00 OHMS .500W 1.0%		
---RF08BW3922F	2	A0273597	RES FILM AX 39.2 KOHM 0.50W 1.0% 100 PPM/C		
---RF49BW0000F	1	A0296948	RES FILM AX 0.0 OHM 0.25W 1.0% 100 PPM/C		
--NT9X3006	1	B0256899	POWER CONVERTER MOTHERBOARD PCP	3	D2
---A0252936	7	A0252936	DIODE SWITCH .2A 75V		
---CA10Z220M100SXA	1	A0636546	CAP AL RL 22.0UF 20% 100.0V 105C 5.0MM SPAN		
---CA11Z512M7R5S	2	A0326471	CAP AL RL 5100.0UF 20% 7.5V 105C 0.0MM SPAN		
---CA13Z561M100SA	2	A0618215	CAP AL RL 560.0UF 20% 100.0V 105C 7.5MM SPAN		
---CB11X7RE105K	1	A0261756	CAP CER RA 1UF 50V 10%		
---CB17X7RD104K	3	A0328980	CAP CER AX 100.0NF 10.0% 50.0V X7R 5.080MM LONG		
---CB17Z5UB105M	3	A0368196	CAP CER AX 1UF 50V +20-20%		
---CB18X7RB104K	2	A0252195	CAP CER AX 0.1UF 100V 10%		
---CM06Y106J100	4	A0293095	CAP PE RA 10UF 100V 5%		
---CP01Y332K400	2	A0258758	CAP PP AX 3.3NF 400V 10%		
---CP06Y223K400C	2	A0382051	CAP, POLYPRO, RAD, 22NF, 10%, 400V, 15MM SPAN		
---CPP02A04B01	2	A0319145	CONN STR HEADER 1X4 ARRAY 0.100 PITCH AUPD STR PCB		
---CPP32A20B01	1	A0322318	CONN STR HEADER 2X10 ARRAY 0.100 PITCH AUPD STR PC		
---CR01X224M250	4	A0345471	CAP EMI RA 220.00NF 20.000% 250.0V 85C 20.3MM SPAN		
---CTP19P64ZNS9	2	A0326972	CONN RT HEADER, P. DIN 4X16 ARRAY 0.200 PITCH AU M		
---NPS25028L2C	2	A0264710	CONN PCB TEST N/A ARRAY 0.400 PITCH AU FEMALE RT P		
---NPS50024-02L8	1	A0379552	EXTRUDED HEATSINK, FOR T0-220/218, E/W SOLDERABLE		
---NT9X3001	1	P0661406	PCB FOR NT9X30AA	4	6
---NTH403AG	1	A0363105	INDUCTOR POWER		
---NTH433AN	1	A0601152	INDR POWER INDUCTOR THRU-HOLE 3.270 UH		
---NTT441AR	1	A0381975	DRIVER TRANSFORMER		
---P0183093	4	P0183093	LOCK WASHER		
---P0210814	1	P0210814	SCREW,PAN HEAD(MACH),SLOTTED, 0.112-40 X 0.625		
---P0247375	1	P0247375	NUT,HEX,MACHINE SCREW, 0.112-40		
---P0298848	4	P0298848	MACHINE SCREW MACH SCR S PAN HEAD SLO		
---P0298849	4	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
---P0387666	16	P0387666	LOCK WASHER		
---P042B394	8	P042B394	CAP SCREW		
---P0661459	7	P0661459	SCREW MACH, (HEX WASHER SCREW, HEX WSHR HEAD (N		
---P0691877	7	P0691877	SHOULDER WASHER		
---P0692046	2	P0692046	SEMI-CONDUCTOR INSULATOR, BERGQUIST CO PPK4-102		
---P0913419	4	P0913419	SILPAD		
---P0913421	2	P0913421	BUSBAR		
---P0913422	2	P0913422	HEATSINK		
---P0913436	1	P0913436	HEATSINK 2		
---P1148	1	A0809168	PUSH PULL TRANSFORMER		
---P1149	1	A0809169	COMMON MODE EMI INDUCTOR		
---P1150	1	A0809162	CURRENT SENSE TRANSFORMER		
---QD-1N4004	1	A0243582	DIODE RECTIFIER 400V 1A		
---QD-1N4937	2	A0258779	DIODE FAST RECOVERY 600V 1A		
---QD-1N5231B	2	A0260857	DIODE ZENER <1W 5.1V		
---QD-1N5244B	1	A0291390	DIODE ZENER <1W 14V		
---QD-1N5406	2	A0287586	DIODE, RECTIFIER, 600V 3A		
---QD-1N5818	4	A0262959	DIODE RECT SCHOTTKY 1A 30V		

---QD-550-2406	1	A0297222	DIODE, LED, RED, RT-ANG				
---QD-MBR6045WT	4	A0670682	DIODE, RECTIFIER, SCHOTTKY, DUAL, 45V 2X30A				
---QFF4A5	1	A0259505	FUSE, FAST, AX, 3A, 125V, PICO				
---QM431-1CZ5	1	A0312039	IC LINEAR VOLTAGE REFERENCE				
---QT-BS107	2	A0325326	TRANSISTOR MOSFET N-CH 200VDS 0.25A				
---QT-IRFP150	2	A0353214	TRANSISTOR, MOSFET, N-CH, 100VDS 41A 0.055OHM				
---QT-IRFP250	4	A0354743	TRANSISTOR MOSFET N-CH 200VDS 30A 0.085OHM				
---QT-MJE200	2	A0361903	TRANSISTOR NPN 25V 5A				
---QT-MJE210	2	A0361904	TRANSISTOR PNP 25V 5A				
---QT-PN2907A	1	A0272995	TRANSISTOR PNP SMALL SIGNAL 60VCE 0.6A				
---QV-V100ZA15	1	A0279964	VARISTOR SUR SUPP				
---RF06BW1001F	5	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL				
---RF06BW10R0F	3	A0264277	RES FILM 10.00 OHMS .250W 1.0%				
---RF06BW2002F	1	A0255548	RES, FILM, 20000.000 OHMS .250 POWER, 1.00 TOL				
---RF06BW20R0F	7	A0271819	RES FILM 20.00 OHMS .250W 1.0%				
---RF06BW3320F	2	A0253463	RES, FILM, 332.000 OHMS .250 POWER, 1.00 TOL				
---RF06BW3321F	1	A0258293	RES, FILM, 3320.000 OHMS .250 POWER, 1.00 TOL				
---RF06BW3322F	1	A0255550	RES, FILM, 33200.000 OHMS .250 POWER, 1.00 TOL				
---RF06BW3572F	1	A0253464	RES, FILM, 35700.000 OHMS .250 POWER, 1.00 TOL				
---RF06BW4322F	1	A0271939	RES FILM 43200.00 OHMS .250W 1.0%				
---RF06BW4750F	1	A0271963	RES FILM 475.00 OHMS .250W 1.0%				
---RF06BW5110F	2	A0263182	RES FILM 511.00 OHMS .250W 1.0%				
---RF06BW51R1F	1	A0271978	RES FILM 51.100 OHMS .250W 1.0%				
---RF08BW2002F	2	A0273457	RES FILM 20000.00 OHMS .500W 1.0%				
---RF08BW2212F	2	A0273473	RES FILM AX 22.1 KOHM 0.50W 1.0% 100 PPM/C				
---RF08BW2R00F	2	A0273445	RES FILM AX 2.0 OHM 0.50W 1.0% 100 PPM/C				
---RF14BX2R00F	2	A0602484	RES FILM AX 2.0 OHM 2.00W 1.0% 200 PPM/C				
---RF14BX33R0J	1	A0249094	RES, FILM, 33.000 OHMS 2.000 POWER, 5.00 TOL				
---RF14BX4301G	1	A0264251	RES FILM 4300.00 OHMS 2.00W 2.0%				
---RF14BX5601G	2	A0257166	RES, FILM, 5600.000 OHMS 2.000 POWER, 2.00 TOL				
---RF19BX24R0J	2	A0236443	RES, FILM, 24.000 OHMS 7.000 POWER, 5.00 TOL				
---RSP25H2C05	4	A0669418	RLY FL SPG PLSTC SLD PCB 5.0V 2C				
---RSP25H2C24	2	A0380993	RLY FL SPG PLSTC SLD PCB 24.0V 2C				
---SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION				
---SPC27C9R5PBS	1	A0382054	SW ROCKER 2PDT (ON)-ON-(ON) RT PC TERM				
---TP01BZ200P050	1	A0274859	THERMISTOR, 20.00 OHMS, TOL= 30.0 SIZE= .550X.100				
--P0116654	2	P0116654	MACHINE SCREW MACH SCR S PAN HEAD SLO				
--P0125084	2	P0125084	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.125-40				
--P0183093	2	P0183093	LOCK WASHER				
--P0284133	2	P0284133	WASHER, NOMINAL #2, STEEL, 289A				
--P0297882	7	P0297882	RIVET,MATL CODE=S 289A FNSH,DIA=0.123,0.188 LG				
--P0298848	2	P0298848	MACHINE SCREW MACH SCR S PAN HEAD SLO				
--P0298849	2	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56				
--P0356522	2	P0356522	WSR LOCK INT TOOTH 0.141-0.295 X 0.022				
--P0613408	9	P0613408	PLASTITE 60-1, 0.123-20X0.312, HEX WSHR HD, STEEL,				
--P0667988	2	P0667988	TENSION WASHER				
--P0668764	2	P0668764	FRONT LATCH				
--P0669000	1	P0669000	POWER FACEPLATE				
--P0669003	9	P0669003	GASKET HOLDER				
--P0672364	1	P0672364	LIGHT PIPE				
--P0675704	1	P0675704	+5V POWER SUPPLY LABEL				
--P0676196	2	P0676196	KNURLED HEADER PIN				
--P0697673	9	P0697673	EMI FINGER GASKET (POWER PACK)				
--P0732222	2	P0732222	SEMS, EXR TOOTH WSHR PAN HD, CR TYPE1A, 0.112-40 X				
--P0913420	1	P0913420	STIFFENER				
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	7F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	7F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	8F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	8F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	9F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	9F	
NTZZ10CD	1	B0245896	ENET 16M CPU	SCC 00	13	10F	
QTY UN	CPC-CODE	ENGINEERING C(	DESCRIPTION/				
1.00 EA	B0231091	NT9X13KA	CPU (16M BYTE DRAM ENET) CP				
1.00 EA	B0229361	NT9X26AB	REMOTE TERMINAL INTERFACE CP				
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	14F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	14F	
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	15F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	15F	
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	16F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	16F	
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	17F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	17F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	18F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	18F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	19F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	19F	
NTZZ10CD	1	B0245896	ENET 16M CPU	SCC 00	13	20F	
QTY UN	CPC-CODE	ENGINEERING C(	DESCRIPTION/				
1.00 EA	B0231091	NT9X13KA	CPU (16M BYTE DRAM ENET) CP				
1.00 EA	B0229361	NT9X26AB	REMOTE TERMINAL INTERFACE CP				
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	24F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	24F	
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	25F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	25F	
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	26F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	26F	
NT9X35FA	1	B0231231	4K X 8K X-POINT CP	SCC 00	13	27F	
P0735098	1	P0735098	DESIGN LABEL (NT9X35FA)	SCC 00	13	27F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	28F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	28F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	29F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	29F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	30F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	30F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	31F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	31F	
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	13	32F	
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	13	32F	
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	13	7R	
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	7R	
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	13	8R	
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	8R	
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	13	9R	
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	9R	
NT9X0524	1	B0232340	DS512/DS30 CABLE ASSY	SCC 00	13	13R	
NT9X45BA	1	B0231590	ENET DS512/DS30 INTF PADBD	SCC 00	13	14R	CPFB
P0731527	1	P0731527	DESIGN LABEL (NT9X45BA)	SCC 00	13	14R	
NT9X0524	1	B0232340	DS512/DS30 CABLE ASSY	SCC 00	13	14R	
NT9X45BA	1	B0231590	ENET DS512/DS30 INTF PADBD	SCC 00	13	15R	CPFB
P0731527	1	P0731527	DESIGN LABEL (NT9X45BA)	SCC 00	13	15R	
NT9X40BB	1	B0234418	QUAD DS512 FIBER I/F CPNTA	SCC 00	13	16R	512
P0734155	1	P0734155	DESIGN LABEL (NT9X40BB)	SCC 00	13	16R	
NT9X40BB	1	B0234418	QUAD DS512 FIBER I/F CPNTA	SCC 00	13	17R	512
P0734155	1	P0734155	DESIGN LABEL (NT9X40BB)	SCC 00	13	17R	
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	13	18R	
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	18R	
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	13	19R	
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	19R	
NT9X0524	1	B0232340	DS512/DS30 CABLE ASSY	SCC 00	13	23R	
NT9X45BA	1	B0231590	ENET DS512/DS30 INTF PADBD	SCC 00	13	24R	CPFB

P0731527		1 P0731527	DESIGN LABEL (NT9X45BA)	SCC 00	13	24R	
NT9X0524		1 B0232340	DS512/DS30 CABLE ASSY	SCC 00	13	24R	
NT9X45BA		1 B0231590	ENET DS512/DS30 INTF PADBD	SCC 00	13	25R	CPFB
P0731527		1 P0731527	DESIGN LABEL (NT9X45BA)	SCC 00	13	25R	
NT9X40BB		1 B0234418	QUAD DS512 FIBER I/F CPNTA	SCC 00	13	26R	512
P0734155		1 P0734155	DESIGN LABEL (NT9X40BB)	SCC 00	13	26R	
NT9X40BB		1 B0234418	QUAD DS512 FIBER I/F CPNTA	SCC 00	13	27R	512
P0734155		1 P0734155	DESIGN LABEL (NT9X40BB)	SCC 00	13	27R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	13	28R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	28R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	13	29R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	29R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	13	30R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	30R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	13	31R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	31R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	13	32R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	13	32R	
NT9X6520		1 B0224013	NIM INTERFACE PNL LT 0-8	SCC 00	13L	E	ENBH
NT9X6521		1 B0224014	NIM INTERFACE PNL RT 0-8	SCC 00	13R	I	ENBH
NTZZ34EC		1 B0244617	DMS SNSE LIS COMMON CP	SCC 00	26		
ENGINEERING CODE	QTY	CPC-CODE	DESCRIPTION/				
NT9X74DA		2 B0232626	REPEATER/TERMINATOR CARD				
NTEX20BA		1 B0229295	INTRA F-BUS B TERMINATION				
			PADDLE BOARD CP				
NTEX20AA		1 B0229294	INTRA F-BUS A TERMINATION				
			PADDLE BOARD CP				
P0704361		1 P0704361	DESIGN LABEL (NTEX20BA)				
P0704360		1 P0704360	DESIGN LABEL (NTEX20AA)				
NPS25028L35		1 A0292488	CONN SHORTING LINK 1X2				
			ARRAY 0.100 PITCH AU				
			FEMALE				
		2 P0733871	DESIGN LABEL (NT9X74DA)				
NT9X19EA		1 B0227170	STP POWER FILLER PACK	SCC 00	26	1F	
NTZZ34PA (as above)		1 B0245906	GLOBAL +5V PWR CONVERTER	SCC 00	26	4F	
P0738496		1 P0738496	DESLABEL (NT9X30AB)	SCC 00	26	4F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	8F	
QTY.	CPC-CODE	ENGINEERING CO	DESCRIPTION/				
	1 B0225118	NT9X76AA	STP SIGNALLING TERMINAL CP				
	1 B0232107	NTEX26AA	CHANNEL BUS INTERFACE				
			PADDLE BOARD CP				
	1 P0733875		DESIGN LABEL (NTEX26AA)				
	1 B0236197	NTEX22BB	IPF INTEGRATED PROCESSOR				
			& FBUS INTERFACE CP				
	1 P0738554	P0738554	DESIGNATION LABEL				
			NT9X76AA/NTEX22BB				
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	10F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	12F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	14F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	16F	
NTZZ30MA		1 B0235032	NETWORK INTERFACE UNIT	SCC 00	26	18F	
Product NTZZ30MA							
ENGINEERING CODE	QTY. UN	CPC-CODE	DESCRIPTION/				
	IT		PAS PRODUCT NAME				
NTEX25AA	1.00 EA	B0232106	CHANNEL BUS CONTROLLER CP				
NTEX28AA	2.00 EA	B0232108	LIS DS30 LINK INTERFACE				
			PADDLE BOARD CP				
NT9X7021	2.00 EA	B0232677	INTER CBC CABLE ASSY (LIS)				
NT9X7020	4.00 EA	B0232676	DS30 CABLE ASSEMBLY (LIS)				
	2.00 EA	P0733137	DESIGN LABEL (NTEX28AA)				
NTEX25BA	1.00 EA	B0232625	CHANNEL BUS CONTROLLER CP				
			(RIGHT)				
NTEX22BB	2.00 EA	B0236197	IPF INTEGRATED PROCESSOR				
			& FBUS INTERFACE CP				
	1.00 EA	P0735918	NTEX22BB/NTEX25AA				
			DESIGNATION LABEL INSERT				
	1.00 EA	P0735919	NTEX25BA/NTEX22BB				
			DESIGNATION LABEL INSERT				
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	22F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	24F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	26F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	28F	
NTZZ44DB		1 B0243005	CCS7 8MEG EIJU (CBI)	SCC 00	26	30F	
NT9X19EA		1 B0227170	STP POWER FILLER PACK	SCC 00	26	33F	
P0738496		1 P0738496	DESLABEL (NT9X30AB)	SCC 00	26	36F	
NT9X79BA		1 B0225481	F-BUS EXT CP E/W TERMINAT	SCC 00	26	7R	
P0689622		1 P0689622	DESIGN LABEL NT9X79BA	SCC 00	26	7R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	10R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	10R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	12R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	12R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	14R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	14R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	16R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	16R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	18R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	18R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	20R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	20R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	22R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	22R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	24R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	24R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	26R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	26R	
NT9X19BA		1 B0221846	FILLER PADDLEBOARD CP	SCC 00	26	28R	
P0709516		1 P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	26	28R	
NT9X79BA		1 B0225481	F-BUS EXT CP E/W TERMINAT	SCC 00	26	32R	
P0689622		1 P0689622	DESIGN LABEL NT9X79BA	SCC 00	26	32R	
NT9X0487		4 B0236189	8 PORT DS30 CABLE ASSY FOR	SCC 00	39		
NT9X0483		2 B0236688	16 PORT DS30 I/F CABLE ASS	SCC 00	39		
NT9X7211		2 B0231166	F-BUS CA ASSY (RH) 3 SHELF	SCC 00	39		
NT9X7213		2 B0231168	F-BUS CABLE ASSY RH 3SHELF	SCC 00	39		
NT9X0489		2 B0238359	C28 IML CA OVERHEAD APPL	SCC 00	39		
NTZZ34PC (see previous)		1 B0245907	GLOBAL -5V PWR CONVERTER	SCC 00	39	1F	
NTZZ34PA (see previous)		1 B0245906	GLOBAL +5V PWR CONVERTER	SCC 00	39	4F	
NTZZ34CA		1 B0234535	DMS S-NODE SE MS LIU INTF	SCC 00	39	8F	
Product	Qty	CPC	Title	CIL	REL		
NTZZ34CA		B0234535	DMS SUPERNODE SE MS LIU INTERFACE	3	3		
-NT9X0170		2 B0226959	COMPOSITE CLOCK CABLE ASSY	9	3		
--CRP03G09T50G		1 A0361660	CONN D SUB D ARRAY 0.108 PITCH AU MALE IDT 2426				
--CRP04G09T50G		1 A0361661	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE IDT 2426				
--CRP14M011		2 A0288282	CONN HOOD D SUB D-8ARRAY				
--R0113085		0.82 R0113085 0	5 PAIR, 26AWG (1X26), TCU, PVC INS, PVC JKT, UL246				
-NT9X73BA		2 B0230922	ENHANCED LMS-FBUS RATE ADAPTER CP	10	7		
--CA14X100M050S		3 A0285220	CAP AL AX 10.0UF 20.000% 50.0V 85C				
--CB17Z5UC104Z		87 A0314520	CAP CER AX 0.1UF 50V +80-20%				
--CTP22P360ZN		1 A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F				
--NR12Q14B1001G		1 A0257761	RES, NETWORK, 1000.000 OHMS .100 POWER, 2.00 TOL				
--NR12Q16A27R0G		1 A0297767	RES NETWORK 27.00 OHMS .200W 2.0%				
--NR12Q16B4701G		7 A0255760	RES, NETWORK, 4700.000 OHMS .100 POWER, 2.00 TOL				

-NT9V73BA	1	B0230884	ENHANCED LMS-FBUS RATE ADAPTER FIRMWARE	3	3
--QM2764-25D1	1	A0287402	MEMORY IC, NMOS UVEPROM, 8KX8, 250NS, DIL28		
--QM2764-25D1GQC	1	A0365347	PROGRAMMED DEVICE		2
--QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16		
--QM6331L-55P5GPL	1	A0365333	PROGRAMMED DEVICE		1
--QMGAL20XV10-15LCP5	2	A0362235	MICROCIRCUIT CMOS PROGRAMMABLE GATE ARRAY		
--QMGAL20XV10-15LCP503	1	A0637363	PROGRAMMED DEVICE FOR NT9V73BA		1
--QMGAL20XV10-15LCP503	1	A0637364	PROGRAMMED DEVICE FOR NT9V73BA		1
--QMPAL16L8ACP5	2	A0323967	IC BIPOLAR PAL		
--QMPAL16L8ACP5GPW	1	A0365342	PROGRAMMED DEVICE		1
--QMPAL16L8ACP5GPX	1	A0365343	PROGRAMMED DEVICE		1
--QMPAL16R6ACP5	4	A0323964	IC BIPOLAR PAL		
--QMPAL16R6ACP5GPM	1	A0365334	PROGRAMMED DEVICE		1
--QMPAL16R6ACP5GPN	1	A0365335	PROGRAMMED DEVICE		2
--QMPAL16R6ACP5GPP	1	A0365336	PROGRAMMED DEVICE		1
--QMPAL16R6ACP5GPQ	1	A0365337	PROGRAMMED DEVICE		1
--QMPAL16R8ACP5	1	A0323965	IC BIPOLAR PAL		
--QMPAL16R8ACP5GPY	1	A0365344	PROGRAMMED DEVICE		3
--QMPAL20R8ACP5	4	A0326645	IC BIPOLAR PAL		
--QMPAL20R8ACP5GPR	1	A0365338	PROGRAMMED DEVICE		2
--QMPAL20R8ACP5GPS	1	A0365339	PROGRAMMED DEVICE		1
--QMPAL20R8ACP5GPT	1	A0365340	PROGRAMMED DEVICE		1
--QMPAL20R8ACP5GPV	1	A0365341	PROGRAMMED DEVICE		1
--QMPAL22V10AP5	1	A0344746	MC		
--QMPAL22V10AP5GPK	1	A0365332	PROGRAMMED DEVICE		1
-NT9X7301	1	P0678493	PCB FOR NT9X73AA	3	3
-NTH294AA	1	A0340417	NTH294AA		
-P0183093	5	P0183093	LOCK WASHER		
-P0298849	5	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
-P0552373	2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR		
-P0668559	2	P0668559	4X90 MOUNTING BLOCK		
-P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
-P0668561	2	P0668561	KEY OCTAGON FOR A0324156		
-P0668764	2	P0668764	FRONT LATCH		
-P0668765	2	P0668765	INSERTION AID		
-P0668766	1	P0668766	FRONT FACEPLATE		
-P0668767	1	P0668767	SHEAR PLATE		
-P0675738	1	P0675738	LOGIC CARD CENTER LABEL	2	0
-P0682710	10	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)		
-P0691810	1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344		
-P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1.	2	0
-QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO		
-QM100DLP5	3	A0262491	IC DELAY LINE DIGITAL 5 EQUAL TAPS 20 TO 100 NS		
-QM3486P5	6	A0264669	IC INTRF QUAD RCVR EIA		
-QM3487P5	6	A0264670	IC INTFC QUAD DRVR EIA		
-QM6168-35P5	19	A0322246	MEMORY IC, CMOS SRAM, 4KX4, 35NS, DIL20		
-QM6264-12P5	1	A0314551	MEMORY IC, CMOS SRAM, 8KX8, 120N, DIL28		
-QM74ALS00P5	3	A0291651	IC ALSTTL QUAD NAND		
-QM74ALS02P5	3	A0291652	IC ALSTTL QUAD NOR		
-QM74ALS04P5	7	A0292332	IC ALSTTL HEX INV		
-QM74ALS08P5	6	A0292333	IC ALSTTL QUAD AND		
-QM74ALS109P5	1	A0292264	IC ALSTTL DUAL FF JK		
-QM74ALS138P5	2	A0291866	IC ALSTTL DEMUX 3 - 8		
-QM74ALS175P5	1	A0291865	IC ALSTTL QUAD FF D		
-QM74ALS240P5	1	A0292337	IC ALSTTL OCTAL BUFF INV		
-QM74ALS244P5	18	A0292052	IC ALSTTL OCTAL BUFF 3S		
-QM74ALS245P5	3	A0292053	IC ALSTTL OCTAL BUS XCVR 3S		
-QM74ALS273P5	3	A0311969	IC ALSTTL OCTAL FF D		
-QM74ALS27P5	1	A0292335	IC, LOGIC, ALSTTL TRIPLE NOR 3-IN		
-QM74ALS32P5	5	A0291654	IC ALSTTL QUAD OR		
-QM74ALS373P5	1	A0297219	IC ALSTTL OCTAL LATCH D 3S		
-QM74ALS374P5	26	A0292054	IC ALSTTL OCTAL FF D 3S		
-QM74ALS521P5	6	A0318482	IC ALSTTL COMPARATOR 8-BIT		
-QM74ALS74P5	6	A0292336	IC ALSTTL DUAL FF D		
-QM74ALS874P5	2	A0293739	IC ALSTTL DUAL FF D 4-BIT		
-QM74F00P5	1	A0277832	IC FTTL QUAD NAND		
-QM74F02P5	1	A0287320	IC FTTL QUAD NOR		
-QM74F04P5	2	A0287319	IC FTTL HEX INV		
-QM74F08P5	1	A0287318	IC FTTL QUAD AND		
-QM74F109P5	1	A0291286	IC FTTL DUAL FF JK		
-QM74F10P5	1	A0277833	IC FTTL TRIPLE NAND 3-IN		
-QM74F112P5	1	A0291287	IC FTTL DUAL FF JK		
-QM74F138P5	1	A0291288	IC FTTL DEMUX 3 - 8		
-QM74F163P5	1	A0291292	IC FTTL COUNTER 4-BIT BIN		
-QM74F175P5	1	A0291293	IC FTTL QUAD FF D		
-QM74F20P5	1	A0287316	IC FTTL DUAL NAND 4-IN		
-QM74F240P5	1	A0290926	IC FTTL OCTAL BUFF INV 3S		
-QM74F244P5	5	A0290927	IC FTTL OCTAL BUFF 3S		
-QM74F280P5	14	A0291294	IC FTTL PARITY GENERATOR 9-BIT		
-QM74F30P5	1	A0355395	IC, FTTL, GATE		
-QM74F32P5	2	A0287315	IC FTTL QUAD OR		
-QM74F374P5	8	A0287311	IC FTTL OCTAL FF D 3S		
-QM74F64P5	1	A0297226	IC FTTL AOI 4-2-3-2-IN		
-QM74F74P5	2	A0287314	IC FTTL DUAL FF D		
-QM74F86P5	1	A0291285	IC FTTL QUAD XOR		
-QM74HCT00P5	1	A0323803	IC HCMOS QUAD NAND		
-QM74LS125P5	2	A0260378	IC LSTTL QUAD BUFF 3S		
-QM74LS148P5	1	A0272697	IC LSTTL OCTAL PRIORITY ENCODER 8 - 3		
-QM74LS393P5	5	A0262368	IC LSTTL DUAL COUNTER BIN		
-QM74LS85P5	2	A0259963	IC LSTTL COMPARATOR 4-BIT MAG		
-QM74S38P5	3	A0257838	IC STTL QUAD NAND BUFF OC		
-QM80C31BH1-16P5	1	A0636041	IC, CMOS, MICROCONTROLLER, 8-BIT/16MHZ, 0° C TO 70		
-QMTL7705AE5	1	A0326955	IC LINEAR SUPPLY VOLTAGE SUPERVISOR		
-QMV165FL5	1	A0352324	N04		
-QNM1100P45	1	A0351903	CRYSTAL OSCILLATOR PLASTIC ENCAPSULATED		
-QT-MPQ2907	1	A0310879	XSTR PNP ARRAY 40V 0.6A THRU-HOLE		
-RF06BW1001F	4	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL		
-RF06BW2000F	4	A0265137	RES FILM 200.00 OHMS .250W 1.0%		
-RF06BW2210F	6	A0266442	RES FILM 221.00 OHMS .250W 1.0%		
-RF06BW3320F	6	A0253463	RES, FILM, 332.000 OHMS .250 POWER, 1.00 TOL		
-SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION		
-SCT01B320	7	A0284937	SOCKET DIP 20 POSITION,RIGID INSULATION		
-SCT01B324	7	A0323911	SOCKET DIP 24 POSITION,RIGID INSULATION		
-SCT01B628	1	A0286209	SOCKET DIP 28 POSITION,RIGID INSULATION		
-SIC13B121Q1	1	A0360630	SOCKET PGA 121 POSITION,REMOVABLE INSULATION		
-NT9X79BA	2	B0225481	F-BUS EXTENSION CP E/W TERMINATIONS	10	7
-CA07X4C1R0M050T	3	A0336799	CAP, AL, SMD, 1UF, 20%, 50V, 105C, 4MM SIZE		
-CA07X6C100M050T	1	A0337004	CAP AL SMD 10.0UF 20.0% 50V 105C 6.80MM SIZE		
-CHC1206C0G102J5B	2	A0319227	CAP CER CHIP 1.0NF 5.00% 50.0V C0G 1206		
-CHC1206X7R104K5B	12	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206		
-CHR01A1001	9	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A1371	1	A0376343	RES FILM SMT 1.37 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A3921	1	A0312160	RES FILM SMT 3.92 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01A4751	9	A0315266	RES FILM SMT 4.75 KOHM 0.125W 1.00% 100 PPM/C		
-CHR01B1210W	1	A0617889	RES FILM SMT 121.00 OHM 0.250W 1.00% 100 PPM/C		
-CHR01B1500W	1	A0601184	RES FILM SMT 150.00 OHM 0.250W 1.00% 100 PPM/C		
-CHR01B1620W	1	A0617892	RES FILM SMT 162.00 OHM 0.250W 1.00% 100 PPM/C		
-CHR01B1780W	28	A0617890	RES FILM SMT 178.00 OHM 0.250W 1.00% 100 PPM/C		
-CHR01B2000W	4	A0616427	RES FILM SMT 200.00 OHM 0.250W 1.00% 100 PPM/C		
-CHR01B2210W	28	A0601183	RES FILM SMT 221.00 OHM 0.250W 1.00% 100 PPM/C		
-CHR01B2670	22	A0617916	RES FILM SMT 267.00 OHM 0.250W 1.00% 100 PPM/C		

--CHR01B3920W	22	A0617093	RES FILM SMT 392.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B5620W	1	A0617893	RES FILM SMT 562.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B61R9W	4	A0617888	RES FILM SMT 61.90 OHM 0.250W 1.00% 100 PPM/C			
--CHR11A0000	1	A0296797	RES FILM SMT 0.0 OHM (JUMPER) 2 AMP MAX			
--CP01Y512J400	1	A0279011	CAP PP AX 5.1NF 400V 5%			
--CRP04P09ZS2450G	1	A0362039	CONN D SUB D ARRAY 0.108 PITCH AU FEMALE RT PCB FP			
--CRP04P37ZS2450G	2	A0362040	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE RT PCB FP			
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F			
--FUS45X2	2	A0376205	FUSE, FAST, SMD, 2.0A, 125VAC/DC, MOLDED, 2917 SIZ			
--NT9V79BA	1	B0241055	F-BUS EXTENSION CP E/W TERMINATIONS FW	4	3	
---QM28SCID04-90CH5	1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION			
---QM28SCID04-90CH503SB	1	A0783762	PROGRAMMED DEVICE FOR NT9V79BA		1	
--NT9X7901	1	P0678499	PCB FOR NT9X79BA	5	5	
--NTH294AB	2	A0618355	INDR POWER INDUCTOR THRU-HOLE 10.200 UH			
--NTT402AA	1	A0341891	XFMR HF WIDEBAND THRU-HOLE 1 OUTPUTS			
--P0183093	10	P0183093	LOCK WASHER			
--P0298849	10	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56			
--P0552373	2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX W SHR			
--P0668559	2	P0668559	4X90 MOUNTING BLOCK			
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI			
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156			
--P0668769	2	P0668769	INSERTION AID			
--P0668771	1	P0668771	SHEAR PLATE			
--P0675236	1	P0675236	FACEPLATE			
--P0676546	1	P0676546	REAR LATCH			
--P0676696	1	P0676696	REAR UPPER LATCH			
--P0682710	6	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)			
--P0691810	6	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344			
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1	2	0	
--P0703915	3	P0703915	DSUB BECU FINGER GASKET	2	0	
--QB-PG504	1	A0314399	PWR CONV PCB MOUNT DCDC 1W			
--QD-BAS16	4	A0312142	DIODE HIGH-SPEED SWITCH 75VBR 0.2A SMD			
--QD-LPF4004	2	A0600914	DIODE RECTIFIER 400V 1A SMD			
--QD-MBRS140	2	A0369986	DIODE SCHOTTKY 40V 1A SMD			
--QD-SMBJ15CA	4	A0384504	DIO TRANSIENT SUPPRESS 600W 15VRM 24.4VCL BIDIR SM			
--QM26S10H5	1	A0377658	IC BIPOLAR INTF QUAD XCVR(SM)			
--QM319H5	1	A0336564	MC			
--QM337LH5	1	A0609530	MICROCIRCUIT, LINEAR, VOLTAGE REGULATOR, 3-TERMINA			
--QM3486H5	1	A0329245	IC INTRFC QUAD RCVR EIA (SM)			
--QM3487H5	1	A0329244	IC INTRFC QUAD DRVR EIA (SM)			
--QM74ALS00H5	2	A0329229	IC ALSTTL QUAD NAND (SM)			
--QM74ALS02H5	1	A0344994	MC			
--QM74ALS04H5	1	A0329233	IC ALSTTL HEX INV (SM)			
--QM74ALS74H5	1	A0329223	IC ALSTTL DUAL FF D 3S (SM)			
-P0689622	2	P0689622	DESIGNATION LABEL FOR NT9X79BA	2	0	
-P0709458	2	P0709458	DESIGN LABEL (NT9X73BA)	2	0	
NT9X17BB	1	B0231822	MS - 32 PORT CIRCUIT PACK	SCC 00	39	10F
P0726962	1	P0726962	DESIGN LABEL (NT9X17BB)	SCC 00	39	10F
NT9X17BB	1	B0231822	MS - 32 PORT CIRCUIT PACK	SCC 00	39	11F
P0726962	1	P0726962	DESIGN LABEL (NT9X17BB)	SCC 00	39	11F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	39	12F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	39	12F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	39	13F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	39	13F
NT9X17CA	1	B0223968	MS 128 PORT CIRCUIT PACK	SCC 00	39	14F
P0678441	1	P0678441	DESIGN LABEL (NT9X17CA)	SCC 00	39	14F
NT9X17CA	1	B0223968	MS 128 PORT CIRCUIT PACK	SCC 00	39	15F
P0678441	1	P0678441	DESIGN LABEL (NT9X17CA)	SCC 00	39	15F
NTZZ34JF	1	B0246097	SNSE MS PROCESSOR	SCC 00	39	17F
Product	Qty	CPC	Title	CIL	REL	
NTZZ34JF		B0246097	SNSE MS PROCESSOR	1	1	
-NT9X13NA	2	B0231195	CPU REMOTE CP	23	12	
--A0344705	1	A0344705	IC CMOS SCC 8MHZ (SM)			
--A0346030	2	A0346030	IC FTTL QUAD XCVR 3S (SM)			
--A0352603	1	A0352603	S39 SUD			
--CA07X4C1R0M050T	28	A0336799	CAP, AL, SMD, 1UF, 20%, 50V, 105C, 4MM SIZE			
--CA07X6C470M016T	13	A0337006	CAP AL SMD 47.0UF 20.0% 16V 105C 6.60MM SIZE			
--CHC1206C0G331J1B	6	A0351440	CAP, CERAMIC CHIP, 330PF, 100V, 5%, 1206 SIZE, NIC			
--CHC1206X7R103K5B	2	A0319234	CAP CER CHIP 10.0NF 10.00% 50.0V X7R 1206 NICKEL			
--CHC1206X7R104K5B	130	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206			
--CHR01A1001	9	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1002	1	A0293769	RES FILM SMT 10.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1132	2	A0292393	RES FILM SMT 11.30 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1501	5	A0323939	RES FILM SMT 1.50 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1502	1	A0291517	RES FILM SMT 15.00 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A1621	1	A0319363	RES FILM SMT 1.62 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A2211	1	A0310648	RES FILM SMT 2.21 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01A23R7	1	A0346791	RES FILM SMT 23.70 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A4750	7	A0312158	RES FILM SMT 475.00 OHM 0.125W 1.00% 100 PPM/C			
--CHR01A4751	29	A0315266	RES FILM SMT 4.75 KOHM 0.125W 1.00% 100 PPM/C			
--CHR01B1000	2	A0385496	RES FILM SMT 100.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B1100W	6	A0617322	RES FILM SMT 110.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B1500W	1	A0601184	RES FILM SMT 150.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B2210W	9	A0601183	RES FILM SMT 221.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B3320W	8	A0617043	RES FILM SMT 332.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B3920W	6	A0617093	RES FILM SMT 392.00 OHM 0.250W 1.00% 100 PPM/C			
--CHR01B51R1W	5	A0613548	RES FILM SMT 51.10 OHM 0.250W 1.00% 100 PPM/C			
--CHR11A0000	7	A0296797	RES FILM SMT 0.0 OHM (JUMPER) 2 AMP MAX			
--CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F			
--FUS45X4.0	1	A0621603	FUSE SMD FAST 4.000A 125VAC/DC 2917 SIZE			
--NT9V13NA	1	B0232149	WSSPR CM PROCESSOR FIRMWARE	11		
---243-07079-0001	1	A0699036	IC,COMPLEX PROGRAMMABLE LOGIC DEVICE, 70MHZ			
---QM27C512-15T5	4	A0379442	MEMORY IC, CMOS OTPROM, 64KX8, 150NS, PLCC32			
---QM27C512-15T503RSA	1	A0646950	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QM27C512-15T503RSB	1	A0646951	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QM27C512-15T503RSC	1	A0646952	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QM27C512-15T503RSD	1	A0646953	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QM28SCID04-90CH5	1	A0622867	MEMORY IC, CMOS ID EEPROM WITH SOFTWARE PROTECTION			
---QM28SCID04-90CH503RR	1	A0646947	PROGRAMMED DEVICE FOR NT9X13NA		1	
---QMGAL16V8-7LCT5	1	A0602363	IC EECMOS PAL, 7.5NS, PLCC (20-PIN), 100MHZ			
---QMGAL16V8-7LCT503RR	1	A0646946	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QMGAL20V8A-10LCT5	1	A0384350	MICROCIRCUIT,EECMOS,PROGRAMMABLE			
---QMGAL20V8A-10LCT503R	1	A0646948	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QMPALCE22V10H-15CT5	2	A0352108	IC EECMOS PAL 15NS (SM)			
---QMPALCE22V10H-15CT5(	1	A0646944	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QMPALCE22V10H-15CT5(	1	A0646945	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QMPALCE26V12H-15CT5	1	A0383946	MICROCIRCUIT,EECMOS,PROGRAMMABLE LOGIC			
---QMPALCE26V12H-15CT5(	1	A0646949	PROGRAMMED DEVICE FOR NT9X13NA		2	
---QMPLSI1032EIP-70CT503	1	A0773657	PROGRAMMED DEVICE FOR NT9V13KA		1	
--NT9X1320	1	P0890975	PCB FOR 9X13KA 16 MEG SIMPLEX CPU	1	6	
--NTH295AA	1	A0340418	INDUCTOR 1UH			
--P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI			
--P0668561	2	P0668561	KEY OCTAGON FOR A0324156			
--P0668764	2	P0668764	FRONT LATCH			
--P0668766	1	P0668766	FRONT FACEPLATE			
--P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI			
--P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH			
--P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH			
--P0696299	1	P0696299	LABEL, CIRCUIT PACK L.E.D.			
--P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1.	2	0	
--P0719254	2	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688			

-P0727020		1	P0727020	10 X 15 DIE CAST STIFFENER	5	0
-P0802169		1	P0802169	LIGHT PIPE		
-QD-HSMSTX00		1	A0386229	DIODE, LED, RED, SMD		
-QD-MBRS140		1	A0369986	DIODE SCHOTTKY 40V 1A SMD		
-QFF4A16		1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO		
-QM-CY7C192-15T5		6	A0732693	MEMORY IC, CMOS SRAM, 64KX4, 15NS, SOJ28, SEP I/O		
-QM-DS1000Z-25H5		1	A0609643	MICROCIRCUIT, CMOS SILICON DELAY LINE, 5-TAP		
-QM-DS1000Z-50H5		1	A0609644	MICROCIRCUIT, CMOS SILICON DELAY LINE, 5-TAP		
-QM26LS31H5		1	A0378049	IC INTRF DRVR (SM)		
-QM27DL-1P5		1	A0344784	MC		
-QM44C4001-60ST5		10	A0617108	MEMORY IC, CMOS DRAM, PAGE 5V, 4MX4, 60NS, SOJ26/2		
-QM628128-15T5		1	A0600456	MEMORY IC, CMOS SRAM, 128KX8, 15NS, SOJ32(400MIL)		
-QM628128-20T5		5	A0380308	MEMORY IC, CMOS SRAM, 128KX8, 20NS, SOJ32(400MIL)		
-QM68020E-20F5		1	A0383771	MICROCIRCUIT, 32-BIT/20 MHZ PROCESSOR		
-QM74ACT112H5		1	A0383373	ACT LOGIC, FLIP-FLOP, DUAL J-K TYPE		
-QM74F00H5		1	A0344991	LOGIC, FAST, QUAD 2-INPUT NAND GATE		
-QM74F04H5		2	A0344794	HEX INVERTER		
-QM74F08H5		2	A0344795	MC		
-QM74F10H5		2	A0337023	MC		
-QM74F240H5		1	A0325315	IC FTTL OCTAL BUFF INV 3S (SM)		
-QM74F241H5		3	A0353006	IC, FTTL, OCTAL DRIVER		
-QM74F244H5		13	A0344819	IC, FTTL, OCTAL DRIVER		
-QM74F245H5		5	A0346784	MC		
-QM74F32H5		3	A0344796	MC		
-QM74F373H5		6	A0344820	MC		
-QM74F38H5		1	A0329260	IC FTTL QUAD NAND BUFF OC (SM)		
-QM74F543H5		9	A0329256	IC FTTL OCTAL BUS XCVR 3S (SM)		
-QM74F74H5		1	A0322324	IC FTTL DUAL FF D (SM)		
-QMTL7702AH5		1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)		
-QMV173DY1		1	A0768492	MEMORY ACCESS UNIT, AMIG533S .5UM PROCESS, 144CPGA		
-QMV343CY1		1	A0768667	MAINTENENACE CONTROLLER CHIP,5 VOLT,AMIG533S .5 UM		
-QNM1152PSRAT16.00		1	A0385594	CRYSTAL CLOCK OSCILLATOR, 16.00 MHZ, TTL, +-100 PP		
-QNM1152PSRAT32.00		1	A0378693	XTAL OSCILLATOR, 32.00MHZ, TTL, TRISTATE, SURFACE		
-QNM1180PSCAT3.6864		1	A0649647	OSC		
-RNS01W16A103G		1	A0362029	RES NET SMT 10.0 KOHM 0.16W 2.0% 8 RES 16 PINS		
-RNS01W16A220G		6	A0345642	RES NET SMT 22.0 OHM 0.16W 2.0% 8 RES 16 PINS		
-RNS01W16A681G		4	A0362028	RES NET SMT 680.0 OHM 0.16W 2.0% 8 RES 16 PINS		
-RNS01W16B222G		3	A0351492	RES NET SMT 2.2 KOHM 0.08W 2.0% 15 RES 16 PINS		
-RNS01W16B472G		5	A0353741	RES NET SMT 4.7 KOHM 0.08W 2.0% 15 RES 16 PINS		
-SIC13A145Q1		2	A0329610	SOCKET PGA 145 POSITION,REMOVABLE INSULATION		
-SIC13B145Q1		1	A0360629	SOCKET PGA 145 POSITION,REMOVABLE INSULATION		
-NT9X26AB		2	B0229361	REMOTE TERMINAL INTERFACE CP	17	30
--A0253336		3	A0253336	RES FILM 10 KOHM 1/4W 1%		
--CA14X470M010S		1	A0291583	CAP AL AX 47.0UF 20.000% 10.0V 85C		
--CB17X7RA103J		1	A0271560	CAP CER AX 0.01UF 50V 5%		
--CB17X7RA104K		12	A0252189	CAP CER AX 100.0NF 10.0% 50.0V X7R 5.080MM LONG		
--CB17X7RA471K		8	A0252339	CAP CER AX 470PF 50V 10%		
--CRP04P25ZS2450G		2	A0362038	CONN D SUB D ARRAY 0.109 PITCH AU FEMALE RT PCB FP		
--CTP22P360ZN		1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F		
--NR12Q16B1001G		1	A0255715	RES, NETWORK, 1000.000 OHMS .100 POWER, 2.00 TOL		
--NR12Q16B1002G		2	A0254367	RES, NETWORK, 10000.000 OHMS .100 POWER, 2.00 TOL		
--NT9V26AB		1	B0230738	REMOTE TERMINAL INTERFACE CP FIRMWARE	4	3
---A0364977		1	A0364977	PROGRAMMED DEVICE		1
---QM27C256-20D1		1	A0329509	MEMORY IC, CMOS UVEPROM, 32KX8, 200NS, DIL28		
---QM6331L-55P5		1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16		
---QM6331L-55P503FMT		1	A0356626	MICROCIRCUIT		1
-NT9X2603		1	P0701880	REMOTE TERMINAL INTERFACE PCB	3	3
--P0180924		4	P0180924	SCR PHM 0.112-40 X 0.312 X 0.219		
--P0183093		5	P0183093	LOCK WASHER		
--P0247375		4	P0247375	NUT,HEX,MACHINE SCREW, 0.112-40		
--P0249752		4	P0249752	LOCK WASHER		
--P0298849		5	P0298849	NUT, MATL CODE= S 289A FIN ISH, THD SIZE= 0.086-56		
--P0552373		2	P0552373	THREAD FORMING SCREW SCR THD FMG S HEX WSHR		
--P0668559		2	P0668559	4X90 MOUNTING BLOCK		
--P0668560		2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI		
--P0668561		2	P0668561	KEY OCTAGON FOR A0324156		
--P0668769		2	P0668769	INSERTION AID		
--P0668771		1	P0668771	SHEAR PLATE		
--P0675237		1	P0675237	FACEPLATE		
--P0676546		1	P0676546	REAR LATCH		
--P0676696		1	P0676696	REAR UPPER LATCH		
--P0682710		6	P0682710	TUBULAR RIVET OVAL HEAD (SEMI-TUBULAR)		
--P0691810		1	P0691810	GUP SCREW SLOTTED PAN HEAD 0.086-56 X 0.344		
--P0703654		1	P0703654	REAR CARD LED LABEL		
--P0703914		7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1.	2	0
--P0703915		2	P0703915	DSUB BECU FINGER GASKET	2	0
--QB-PG504		1	A0314399	PWR CONV PCB MOUNT DCDC 1W		
--QD-1N5232B		1	A0266652	DIODE ZENER <1W 5.6V		
--QD-1N5254B		2	A0277530	DIODE ZENER <1W 27V		
--QD-HLMP1301A		1	A0361553	DIODE LED RED RT ANG T-1 CASE		
--QD-HLMP1523A		1	A0361552	DIODE LED GREEN RT ANG T-1 CASE		
--QFF4A7		1	A0259507	FUSE, FAST, AX, 5A, 125V, PICO		
--QM3486P5		1	A0264669	IC INTRF QUAD RCVR EIA		
--QM3487P5		1	A0264670	IC INTFC QUAD DRVR EIA		
--QM4N32E5		1	A0260588	IC OPTOCOUPLER		
--QM4N37E5		1	A0263562	OPTICAL COUPLER		
--QM62256L-10P5		1	A0345670	MEMORY IC, CMOS SRAM, 32KX8, 100NS, DIL28(600MIL)		
--QM74ALS00P5		1	A0291651	IC ALSTTL QUAD NAND		
--QM74ALS153P5		1	A0320778	IC ALSTTL DUAL MUX 4 - 1		
--QM74ALS175P5		1	A0291865	IC ALSTTL QUAD FF D		
--QM74ALS20P5		1	A0292334	IC ALSTTL DUAL NAND 4-IN		
--QM74ALS244P5		2	A0292052	IC ALSTTL OCTAL BUFF 3S		
--QM74ALS32P5		1	A0291654	IC ALSTTL QUAD OR		
--QM74ALS373P5		1	A0297219	IC ALSTTL OCTAL LATCH D 3S		
--QM74ALS374P5		2	A0292054	IC ALSTTL OCTAL FF D 3S		
--QM74F132P5		1	A0329402	MC		
--QM74F240P5		1	A0290926	IC FTTL OCTAL BUFF INV 3S		
--QM74F244P5		2	A0290927	IC FTTL OCTAL BUFF 3S		
--QM74F38P5		1	A0316946	IC FTTL QUAD NAND BUFF OC		
--QM74HC4040P5		2	A0312201	IC HCMOS CNTR BIN 12-STAGE		
--QM74HCT00P5		1	A0323603	IC HCMOS QUAD NAND		
--QM74HCT74P5		1	A0322798	IC CMOS DUAL FF D		
--QM74LS139P5		1	A0257853	IC LSTTL DUAL DEMUX 2 - 4		
--QM74LS164P5		2	A0252998	IC LSTTL SHIFT REG 8-BIT S-P		
--QM74LS393P5		3	A0262368	IC LSTTL DUAL COUNTER BIN		
--QM75188P5		1	A0264141	IC INTFC QUAD LINE DRVR (EIA)		
--QM75189AP5		1	A0263690	IC QUAD LINE RCVR		
--QM80C31P5		1	A0320710	IC CMOS UP 8-BIT		
--QM8530AP5		1	A0319350	IC 6 MEG SERIAL COMMUNICATION CONTROLLER		
--QMTL7702AE5		1	A0327091	MICROCIRCUIT, LINEAR SUPPLY VOLTAGE SUPERVISOR		
--QNM1100A44		1	A0298025	OSC CLOCK 11.059MHZ 100.000PPM		
--QT-2N3904		1	A0262479	XSTR NPN SMALL SIGNAL GENERAL 40V 0.2A THRU-HOLE		
--QT-2N3906		1	A0253314	XSISTOR PNP SM SIG GEN PUR		
--RF06BW1000F		2	A0271689	RES FILM 100.00 OHMS .250W 1.0%		
--RF06BW1001F		5	A0252977	RES, FILM, 1000.000 OHMS .250 POWER, 1.00 TOL		
--RF06BW1003F		3	A0253438	RES, FILM, 100000.000 OHMS .250 POWER, 1.00 TOL		
--RF06BW1211F		4	A0255637	RES, FILM, 1210.000 OHMS .250 POWER, 1.00 TOL		
--RF06BW1502F		1	A0253457	RES, FILM, 15000.000 OHMS .250 POWER, 1.00 TOL		
--RF06BW1820F		2	A0271801	RES FILM 182.00 OHMS .250W 1.0%		
--RF06BW2490F		1	A0264788	RES FILM 249.00 OHMS .250W 1.0%		
--RF06BW3010F		1	A0271887	RES FILM 301.00 OHMS .250W 1.0%		

--RF06BW3011F	2	A0253460	RES, FILM, 3010.000 OHMS .250 POWER, 1.00 TOL				
--RF06BW3012F	1	A0271888	RES FILM 30100.00 OHMS .250W 1.0%				
--RF06BW3013F	1	A0255781	RES, FILM, 301000.000 OHMS .250 POWER, 1.00 TOL				
--RF06BW3320F	2	A0253463	RES, FILM, 332.000 OHMS .250 POWER, 1.00 TOL				
--RF06BW51R1F	1	A0271978	RES FILM 51.100 OHMS .250W 1.0%				
--RF49BW0000F	1	A0296948	RES FILM AX 0.0 OHM 0.25W 1.0% 100 PPM/C				
--SCT01B316	1	A0286206	SOCKET DIP 16 POSITION,RIGID INSULATION				
--SCT01B628	1	A0286209	SOCKET DIP 28 POSITION,RIGID INSULATION				
NT9X53AD	1	B0238070	DMS BUS SYS CLOCK CP	SCC 00		39	18F
ENGINEERING CODE	QTY.	CPC-CODE	DESCRIPTION/				
NT9V53AD	1	B0238246	DMS-BUS SYSTEM CLOCK				
			FIRMWARE				
NT9X5305	1	P0740183	COMBINED CLOCK STRATUM 1				
			PCB (NT9X5303)				
P0703914	7	P0703914	FACEPLATE EMI FINGER				
			GASKET, 3 FINGERS,				
			LENGTH: 1.				
P0668764	2	P0668764	FRONT LATCH				
P0668766	1	P0668766	FRONT FACEPLATE				
P0668561	2	P0668561	KEY OCTAGON FOR A0324156				
P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X				
			0.312 IN LONG WITH 289A FI				
	1	P0802169	LIGHT PIPE				
P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER				
NT6L34AA	1	A0602500	CONVERTER DC/DC 5V/5V PCB				
			MOUNTING				
NPS60154L26	1	A0324056	+/- 15 VOLTS				
	10	P0691817	GUP #4-40 HEX WASHER HEAD				
			MACH				
	4	P0691821	GUP #4-40 WASHER HEAD MACH				
	6	P0691815	SHOULDER SCREW, HEX HEAD,				
			THREAD: 0.112-40, MATERI				
	2	P0719254	RIVET, MATL CODE= S 289A				
			FINISH, DIA= 0.123 0.688				
CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT				
			4X90 ARRAY 0.100 PITCH AU				
SCT01B628	1	A0286209	SOCKET DIP 28 POSITION,				
			RIGID INSULATION				
CA07X6C470M016T	1	A0337006	CAP AL SMD 47.0UF 20.0%				
			16V 105C 6.60MM SIZE				
CA07X6C150M025T	4	A0601079	CAP AL SMD 15.0UF 20.0%				
			25V 105C 6.60MM SIZE				
ENGINEERING CODE	QTY.	CPC-CODE	DESCRIPTION/				
			PAS PRODUCT NAME				
CA07X5C4R7M050T	1	A0368624	CAP AL SMD 4.7UF 20.0%				
			50V 105C 5.50MM SIZE				
CHC1206X7R104K5B	206	A0328995	CAP CER CHIP 100.0NF				
			10.00% 50.0V X7R 1206				
CHC1206C0G101J2B	1	A0379871	CAP, CER, CHIP, 100PF, 5%,				
			200V, C0G, 1206, NICKEL				
CHC1206C0G102J5B	1	A0319227	CAP CER CHIP 1.0NF 5.00%				
			50.0V C0G 1206				
CHC0805X7R103K1B	1	A0355485	CAP CER CHIP 10.0NF				
			10.00% 100.0V X7R 0805				
QNM1100PST4	1	A0377090	CRYSTAL OSC, TRISTATE,				
			PLASTIC, SMD				
QNM4877MHRAX10.240	1	A0773436	OSC, OCVCXO, METAL PKG,				
			THROUGH - HOLE, 10.24 AND				
QD-HSMGTX00	1	A0386234	DIODE, LED, GREEN, SMD				
QD-SMBG48A	1	A0353170	DIO TRANSIENT SUPPRESS				
			600W 48VRM 77.4VCL SMD				
QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V,				
			PICO				
NTH296AA	1	A0340418	INDUCTOR 1UH				
QM74ALS521H5	2	A0353106	MC				
QM74ALS161H5	1	A0353014	MC				
QM74ALS244H5	12	A0329225	IC ALSTTL OCTAL BUFF 3S				
			(SM)				
QM74ALS109H5	3	A0353011	MC				
QM74ALS374H5	17	A0329222	IC ALSTTL OCTAL FF D 3S				
			(SM)				
QM74ALS534H5	1	A0376843	MICROCIRCUIT, ALSTTL,				
			FLIPFLOP				
QM74ALS175H5	1	A0353015	MC				
ENGINEERING CODE	QTY.	CPC-CODE	DESCRIPTION/				
			PAS PRODUCT NAME				
QM74ALS74H5	14	A0329223	IC ALSTTL DUAL FF D 3S				
			(SM)				
QM74ALS04H5	11	A0329233	IC ALSTTL HEX INV (SM)				
QM74ALS05H5	1	A0353881	MC				
QM74ALS08H5	4	A0329230	IC ALSTTL QUAD AND (SM)				
QM74ALS21H5	2	A0353108	MC				
QM74ALS02H5	2	A0344994	MC				
QM74ALS00H5	1	A0329229	IC ALSTTL QUAD NAND (SM)				
QM74ALS27H5	1	A0345061	IC, LOGIC, ALS, GATE				
QM74ALS32H5	7	A0329228	IC ALSTTL QUAD OR (SM)				
QM74ALS373H5	3	A0329221	IC ALSTTL OCTAL LATCH D				
			3S (SM)				
QM74ALS666H5	11	A0367279	IC ALSTTL LATCH D 8-BIT				
			TRANSPARENT READ/BACK (SM)				
QM74ALS153H5	1	A0329220	IC ALSTTL DUAL MUX 4 - 1				
			(SM)				
QM74ALS164H5	1	A0351465	MICROCIRCUIT, ADVANCED				
			LOW POWER SCHOTTKY, STATIC				
QM74ALS652H5	8	A0353425	IC ALSTTL OCTAL BUS				
			XCVR/REG 3S (SM)				
QM74ALS245H5	4	A0329224	IC ALSTTL OCTAL BUS XCVR				
			3S (SM)				
QM93CS46ESH5	1	A0378635	MEMORY IC, CMOS EEPROM,				
			1K-BIT, 1US, SO8, SERIAL (				
QM7201A-65T5	2	A0353461	IC, CMOS, ASYNCHRONOUS				
			FIFO, 512X9, 65NS, PLCC32				
QM82C54T5	1	A0336545	IC CMOS PROGRAMMABLE				
			INTERVAL TIMER				
QM6207-25T5	1	A0353874	MEMORY IC, CMOS SRAM,				
			256KX1, 25NS, SOJ24, SEP				
			I/O				
QM628128L-100H5	1	A0355453	MEMORY IC, CMOS SRAM,				
			128KX8, 100NS, SOP32				
QM80C31T5	1	A0329243	IC CMOS UP 8-BIT ROMLESS				
			(SM)				
QM74F163H5	12	A0344798	MC				
QM74F132H5	1	A0377509	IC FTTL QUAD NAND SCHMITT				
			TRIGGER (SM)				
QM74F244H5	3	A0344819	IC, FTTL, OCTAL DRIVER				
QM74F38H5	1	A0329260	IC FTTL QUAD NAND BUFF OC				
			(SM)				
QM74F125H5	2	A0345720	MC				
QM74F377H5	9	A0367125	IC FTTL OCTAL FF D (SM)				
QM74F74H5	17	A0322324	IC FTTL DUAL FF D (SM)				
QM74F175H5	3	A0344797	IC FTTL QUAD FF D (SM)				

QM74F32H5	1	A0344796	MC			
QM74F30H5	6	A0353776	MC			
QM74F27H5	1	A0353771	IC, LOGIC			
QM74F04H5	2	A0344794	HEX INVERTER			
QM74F00H5	2	A0344991	LOGIC, FAST, QUAD 2-INPUT			
			NAND GATE			
QM74F08H5	2	A0344795	MC			
QM74F353H5	4	A0377657	IC FTTL DUAL MUX 4 - 1 3S			
			(SM)			
QM74F157H5	4	A0344792	MC			
QM74F251H5	8	A0353007	MC			
QM74F280H5	5	A0346029	MC			
QM74HCT4040H5	5	A0361948	IC HCMOS CNTR BIN			
			12-STAGE (SM)			
QM74HCT166H5	1	A0380189	HCTMOS, 8-BIT SERIAL OR			
			PARALLEL IN AND SERIAL OUT			
QMAD1674JH5	1	A0601767	12-BIT 100 KSPS A/D			
			CONVERTER			
QM339H5	2	A0291552	IC LINEAR QUAD COMPRTR			
			(SM)			
QMDAC709ACD1	1	A0609661	MICROCIRCUIT, LINEAR, D			
			TO A CONVERTER			
QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE			
			SUPERVISOR (SM)			
CHR01A51R1	5	A0321168	RES FILM SMT 51.10 OHM			
			0.125W 1.00% 100 PPM/C			
CHR01A4322	1	A0315170	RES FILM SMT 43.20 KOHM			
			0.125W 1.00% 100 PPM/C			
CHR01A1000	2	A0312154	RES FILM SMT 100.00 OHM			
			0.125W 1.00% 100 PPM/C			
CHR01A6810	2	A0322515	RES FILM SMT 681.00 OHM			
			0.125W 1.00% 100 PPM/C			
CHR01A7501	1	A0315277	RES FILM SMT 7.50 KOHM			
			0.125W 1.00% 100 PPM/C			
CHR01A3320	2	A0319398	RES FILM SMT 332.00 OHM			
			0.125W 1.00% 100 PPM/C			
CHR01A33R2	3	A0329369	RES FILM SMT 33.20 OHM			
			0.125W 1.00% 100 PPM/C			
CHR01A1501	1	A0323939	RES FILM SMT 1.50 KOHM			
			0.125W 1.00% 100 PPM/C			
CHR01A2210	2	A0312162	RES FILM SMT 221.00 OHM			
			0.125W 1.00% 100 PPM/C			
CHR01B1001W	6	A0381056	RES FILM SMT 1.00 KOHM			
			0.250W 1.00% 100 PPM/C			
CHR01A2001	4	A0319399	RES FILM SMT 2.00 KOHM			
			0.125W 1.00% 100 PPM/C			
CHR01A1502	2	A0291517	RES FILM SMT 15.00 KOHM			
			0.125W 1.00% 100 PPM/C			
CHR01A1002	13	A0293769	RES FILM SMT 10.00 KOHM			
			0.125W 1.00% 100 PPM/C			
RNS01W16B472G	7	A0353741	RES NET SMT 4.7 KOHM			
			0.08W 2.0% 15 RES 16 PINS			
QT-MMBT2222A	2	A0322517	TRANSISTOR NPN 40VCE 0.6A			
			SMD			
P0747480	1	P0747480	NT9X53 LED LABEL			
NT9X53AD	1	B0238070	DMS BUS SYS CLOCK CP	SCC 00	39	21F
NT9X17CA	1	B0223988	MS 128 PORT CIRCUIT PACK	SCC 00	39	24F
Product	Qty	CPC	Title	CIL	REL	
NT9X17CA		B0223988	DMS BUS 128 PORT CP	27	10	
-A0345721	1	A0345721	IC FTTL QUAD XOR (SM)			
-A0353008	1	A0353008	IC FTTL QUAD MUX 2 - 1 3S (SM)			
-A0353424	8	A0353424	IC ALSTTL DUAL FF D 4-BIT (SM)			
-A0353425	7	A0353425	IC ALSTTL OCTAL BUS XCVR/REG 3S (SM)			
-A0353427	1	A0353427	IC FTTL OCTAL PRIORITY ENCODER 8 - 3 (SM)			
-A0353428	5	A0353428	IC FTTL DEMUX 3 - 8 (SM)			
-CA07X6C470M016T	1	A0337006	CAP AL SMD 47.0UF 20.0% 16V 105C 6.60MM SIZE			
-CHC1206X7R104K5B	155	A0328995	CAP CER CHIP 100.0NF 10.00% 50.0V X7R 1206			
-CHR01A1001	20	A0312156	RES FILM SMT 1.00 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A1002	11	A0293769	RES FILM SMT 10.00 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A1501	1	A0323939	RES FILM SMT 1.50 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A1780	4	A0315294	RES FILM SMT 178.00 OHM 0.125W 1.00% 100 PPM/C			
-CHR01A2210	11	A0312162	RES FILM SMT 221.00 OHM 0.125W 1.00% 100 PPM/C			
-CHR01A3320	15	A0319398	RES FILM SMT 332.00 OHM 0.125W 1.00% 100 PPM/C			
-CHR01A4751	1	A0315266	RES FILM SMT 4.75 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A51R1	14	A0321168	RES FILM SMT 51.10 OHM 0.125W 1.00% 100 PPM/C			
-CHR01A8061	1	A0315278	RES FILM SMT 8.06 KOHM 0.125W 1.00% 100 PPM/C			
-CHR01A8250	1	A0315448	RES FILM SMT 825.00 OHM 0.125W 1.00% 100 PPM/C			
-CTP22P360ZN	1	A0324156	CONN NORCON, RT RECEPT 4X90 ARRAY 0.100 PITCH AU F			
-CTS10Y2312T100K10	1	A0328922	CAP TAN CHIP 10UF 10V 10% (SM)			
-FUS45X0.062	1	A0382524	FUSE, FAST, SMD, 0.062A, 125VAC/DC, MOLDED, 2917 S			
-FUS45X2	1	A0376206	FUSE, FAST, SMD, 2.0A, 125VAC/DC, MOLDED, 2917 SIZ			
-NT9V17CA	1	B0229531	MS 128 - PORT CIRCUIT PACKFIRMWARE	7	2	
--QM-MACH110-15CT5	1	A0377011	IC CMOS HIGH-DENSITY EE PRGM LOGIC 15NS (SM)			
--QM-MACH130-15CT5	1	A0379599	MICROCIRCUIT CMOS EPLD			
--QM-MACH210-15CT5	3	A0379497	MICROCIRCUIT CMOS EPLD			
--QM6331L-55P5	1	A0322680	MEMORY IC, BIPOLAR FUSIBLE PROM, 32X8, 55NS, DIL16			
--QMGAL20RA10-15LCP5	1	A0382790	MICROCIRCUIT, CMOS, PROGRAMMABLE LOGIC ARRAY			
--TT03HRR	1	A0397838	PROGRAMMED DEVICE		1	
--TT03JTW	1	A0397621	PROGRAMMED DEVICE		2	
--TT03JTX	1	A0397622	PROGRAMMED DEVICE		2	
--TT03JVB	1	A0397474	PROGRAMMED DEVICE		1	
--TT03JVC	1	A0397475	PROGRAMMED DEVICE		2	
--TT03JVD	1	A0397476	PROGRAMMED DEVICE		1	
--TT03JVE	1	A0397477	PROGRAMMED DEVICE		2	
-NT9X1703	1	P0676153	PCB FOR NT9X17CA	6	8	
-NTH295AA	1	A0340418	INDUCTOR 1UH			
-P0668560	2	P0668560	SCREW 0.086-56 UNC-2A X 0.312 IN LONG WITH 289A FI			
-P0668561	2	P0668561	KEY OCTAGON FOR A0324156			
-P0668764	2	P0668764	FRONT LATCH			
-P0668766	1	P0668766	FRONT FACEPLATE			
-P0675738	1	P0675738	LOGIC CARD CENTER LABEL	2	0	
-P0691815	6	P0691815	SHOULDER SCREW, HEX HEAD, THREAD: 0.112-40, MATERI			
-P0691817	10	P0691817	GUP #4-40 HEX WASHER HEAD MACH			
-P0691821	4	P0691821	GUP #4-40 WASHER HEAD MACH			
-P0703914	7	P0703914	FACEPLATE EMI FINGER GASKET, 3 FINGERS, LENGTH: 1.	2	0	
-P0719254	2	P0719254	RIVET, MATL CODE= S 289A FINISH, DIA= 0.123 0.688			
-P0727020	1	P0727020	10 X 15 DIE CAST STIFFENER	5	0	
-QD-SMBG48A	1	A0353170	DIO TRANSIENT SUPPRESS 600W 48VRM 77.4VCL SMD			
-QFF4A16	1	A0270881	FUSE, FAST, AX, 10A, 125V, PICO			
-QM-AM29C821AH5	10	A0376949	MICROCIRCUIT, CMOS, LATCH			
-QM-MK4502-65T5	3	A0354307	IC, CMOS, ASYNCHRONOUS FIFO, 1KX9, 65NS, PLCC32			
-QM28C513-20ET5	2	A0377586	MEMORY IC, CMOS EEPROM, 64KX8, 200NS, DIL28, EPROM			
-QM50DLH5	1	A0379609	50 NS DELAY LINE,5 TAPS, 8PIN SOIC			
□						
Product Structure Report -			Date: 20	NT9X	17CA	
Product	Qty	CPC	Title	CIL	REL	
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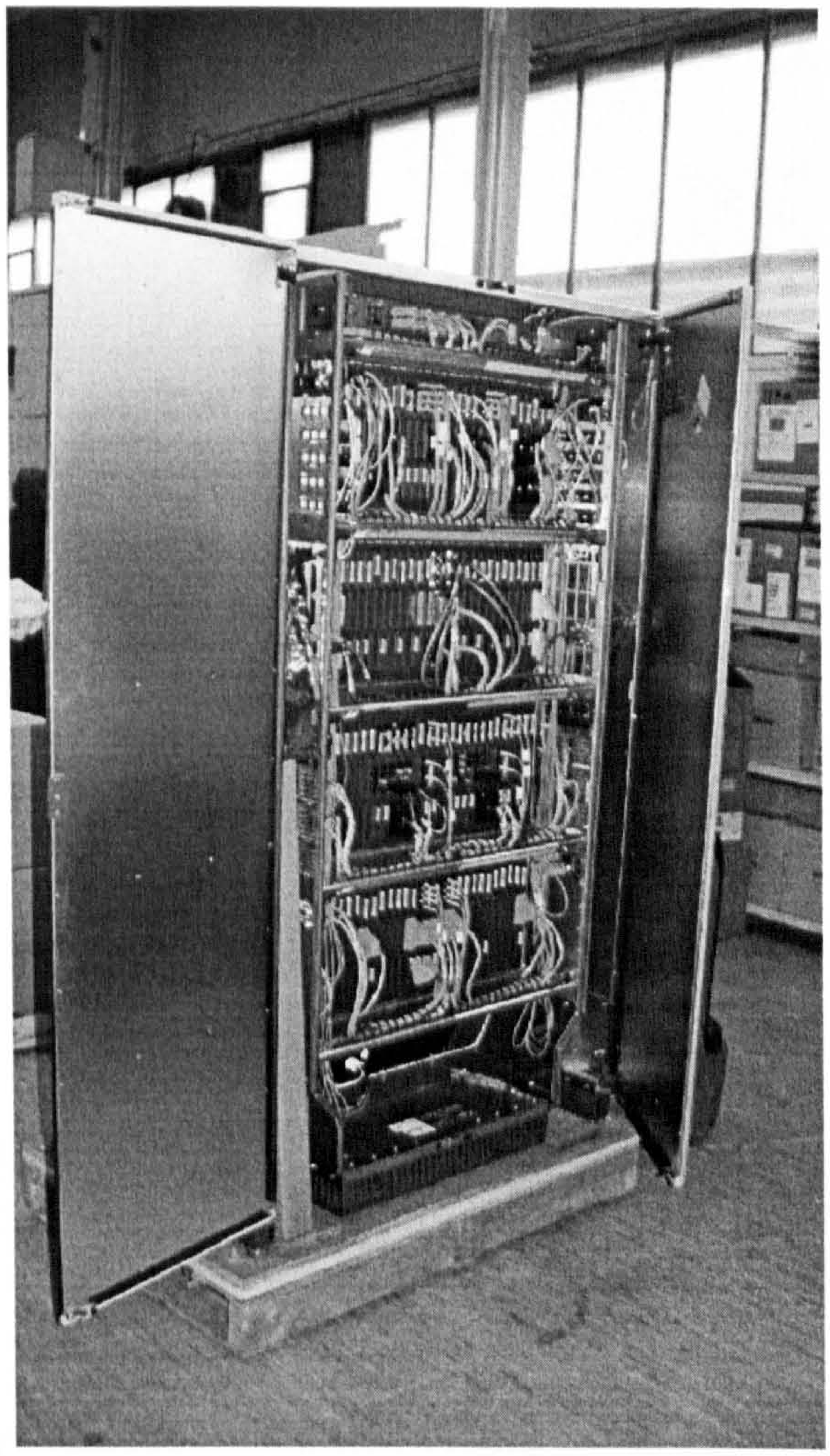
-QM6208-35T5	1	A0369991	MEMORY IC, CMOS SRAM, 64KX4, 35NS, SOJ24			
-QM624256-35T5	22	A0352614	MEMORY IC, CMOS SRAM, 256KX4, 35NS, SOJ28W(400MIL)			
-QM628128-35T5	1	A0378955	MEMORY IC, CMOS SRAM, 128KX8, 35NS, SOJ32(400MIL)			
-QM68EC020-25F5	1	A0382488	MICROCIRCUIT, 32-BIT/25MHZEMBEDDED CONTROLLER			

-QM7201A-65T5	1	A0353461	IC, CMOS, ASYNCHRONOUS FIFO, 512X9, 65NS, PLCC32			
-QM74ABT244H5	30	A0379174	MICROCIRCUIT, ADVANCED BICMOS OCTAL DRIVER			
-QM74ALS00H5	1	A0329229	IC ALSTTL QUAD NAND (SM)			
-QM74ALS02H5	2	A0344994	MC			
-QM74ALS04H5	10	A0329233	IC ALSTTL HEX INV (SM)			
-QM74ALS109H5	7	A0353011	MC			
-QM74ALS10H5	1	A0344993	MC			
-QM74ALS139H5	4	A0344998	MC			
-QM74ALS175H5	1	A0353015	MC			
-QM74ALS20H5	1	A0329234	IC ALSTTL DUAL NAND 4-IN (SM)			
-QM74ALS240H5	1	A0346627	MC			
-QM74ALS244H5	6	A0329225	IC ALSTTL OCTAL BUFF 3S (SM)			
-QM74ALS245-AH5	2	A0678060	IC ALSTTL OCTAL BUS XCVR 3S (SM), SPECIAL FOR NT9X			
-QM74ALS245H5	4	A0329224	IC ALSTTL OCTAL BUS XCVR 3S (SM)			
-QM74ALS32H5	3	A0329228	IC ALSTTL QUAD OR (SM)			
-QM74ALS373H5	5	A0329221	IC ALSTTL OCTAL LATCH D 3S (SM)			
-QM74ALS374H5	22	A0329222	IC ALSTTL OCTAL FF D 3S (SM)			
-QM74ALS521H5	5	A0353106	MC			
-QM74F00H5	3	A0344991	LOGIC, FAST, QUAD 2-INPUT NAND GATE			
-QM74F04H5	2	A0344794	HEX INVERTER			
-QM74F08H5	2	A0344795	MC			
-QM74F109H5	1	A0337252	IC			
-QM74F163H5	2	A0344798	MC			
-QM74F240H5	1	A0325315	IC FTTL OCTAL BUFF INV 3S (SM)			
-QM74F280H5	12	A0346029	MC			
-QM74F32H5	3	A0344796	MC			
-QM74F373H5	1	A0344820	MC			
-QM74F374H5	3	A0344990	MC			
-QM74F38H5	4	A0329260	IC FTTL QUAD NAND BUFF OC (SM)			
-QM74F85H5	1	A0329259	IC FTTL COMPARATOR 4-BIT MAG (SM)			
-QM74HC10H5	1	A0329324	MC			
-QM82C54T5	1	A0336545	IC CMOS PROGRAMMABLE INTERVAL TIMER			
-QMTL7702AH5	1	A0329242	IC LINEAR SUPPLY VOLTAGE SUPERVISOR (SM)			
-QMV164BY1	1	A0361655	IC CUSTOM CMCX (68 PGA NT/SCG PKG)			
-QMV317BY1	4	A0369557	IC CUSTOM MULTIPLE PORT LINK HANDLER 155-PGA			
-QMV318EY1	4	A0736720	QMV318 GATE ARRAY MULTIPORT BUS ACCESS, CPGA155, H			
-QNM1100PST3	1	A0351751	PLASTIC ENCAPSUATED CRYSTAL OSCILLATOR TRISTATE, S			
-QT-MMBT2907A	4	A0322518	TRANSISTOR PNP 60VCE 0.6A SMD			
-RNS01W16B222G	1	A0351492	RES NET SMT 2.2 KOHM 0.06W 2.0% 15 RES 16 PINS			
-RNS01W16B472G	13	A0353741	RES NET SMT 4.7 KOHM 0.06W 2.0% 15 RES 16 PINS			
-SCT01B316	1	A0266206	SOCKET DIP 16 POSITION,RIGID INSULATION			
-SCT01B324	1	A0323911	SOCKET DIP 24 POSITION,RIGID INSULATION			
-SCT09B44	4	A0329848	SOCKET PLCC 44 POSITION,RIGID INSULATION			
-SCT09B84	1	A0345595	SOCKET PLCC 84 POSITION,RIGID INSULATION			
-SIC13A155	8	A0368810	SOCKET PGA 155 POSITION,REMOVABLE INSULATION			
-SIC13A68Q2	1	A0329612	SOCKET PGA 68 POSITION,REMOVABLE INSULATION			
P0678441	1	P0678441	DESIGN LABEL (NT9X17CA)	SCC 00	39	24F
NT9X17CA	1	B0223988	MS 128 PORT CIRCUIT PACK	SCC 00	39	25F
P0678441	1	P0678441	DESIGN LABEL (NT9X17CA)	SCC 00	39	25F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	39	26F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	39	26F
NT9X19AA	1	B0221845	FILLER CIRCUIT PACK	SCC 00	39	27F
P0709515	1	P0709515	DESIGN LABEL (NT9X19AA)	SCC 00	39	27F
NT9X17BB	1	B0231822	MS - 32 PORT CIRCUIT PACK	SCC 00	39	28F
P0726962	1	P0726962	DESIGN LABEL (NT9X17BB)	SCC 00	39	28F
NT9X17BB	1	B0231822	MS - 32 PORT CIRCUIT PACK	SCC 00	39	29F
P0726962	1	P0726962	DESIGN LABEL (NT9X17BB)	SCC 00	39	29F
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	7R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	7R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	9R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	9R
NT9X69BA	1	B0231233	16 LINK DS30 MS PB	SCC 00	39	10R
P0726964	1	P0726964	DESIGN LABEL (NT9X69BA)	SCC 00	39	10R
NT9X69BA	1	B0231233	16 LINK DS30 MS PB	SCC 00	39	11R
P0726964	1	P0726964	DESIGN LABEL (NT9X69BA)	SCC 00	39	11R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	12R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	12R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	13R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	13R
NT9X62CA	1	B0231169	SR512 4 LINK PB E/W OOB RS	SCC 00	39	14R
P0735105	1	P0735105	DESIGN LABEL (NT9X62CA)	SCC 00	39	14R
NT9X62CA	1	B0231169	SR512 4 LINK PB E/W OOB RS	SCC 00	39	15R
P0735105	1	P0735105	DESIGN LABEL (NT9X62CA)	SCC 00	39	15R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	19R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	19R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	20R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	20R
NT9X62CA	1	B0231169	SR512 4 LINK PB E/W OOB RS	SCC 00	39	24R
P0735105	1	P0735105	DESIGN LABEL (NT9X62CA)	SCC 00	39	24R
NT9X62CA	1	B0231169	SR512 4 LINK PB E/W OOB RS	SCC 00	39	25R
P0735105	1	P0735105	DESIGN LABEL (NT9X62CA)	SCC 00	39	25R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	26R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	26R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	27R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	27R
NT9X69BA	1	B0231233	16 LINK DS30 MS PB	SCC 00	39	28R
P0726964	1	P0726964	DESIGN LABEL (NT9X69BA)	SCC 00	39	28R
NT9X69BA	1	B0231233	16 LINK DS30 MS PB	SCC 00	39	29R
P0726964	1	P0726964	DESIGN LABEL (NT9X69BA)	SCC 00	39	29R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	30R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	30R
NT9X19BA	1	B0221846	FILLER PADDLEBOARD CP	SCC 00	39	32R
P0709516	1	P0709516	DESIGN LABEL (NT9X19BA)	SCC 00	39	32R
NT9X6567	1	B0235829	STREAMLINE BULKHD I/F LT	SCC 00	39L	E
NT9X6568	1	B0235830	STREAMLINE BULKHD I/F RT	SCC 00	39R	I
NTZZ10CU	1	B0245897	C42 CAB COOLING UNIT -48V	SCC 00	52	
A0368392	1	A0368392	FSP TERM BLOCK COVER ASSY	SCC 00	52	

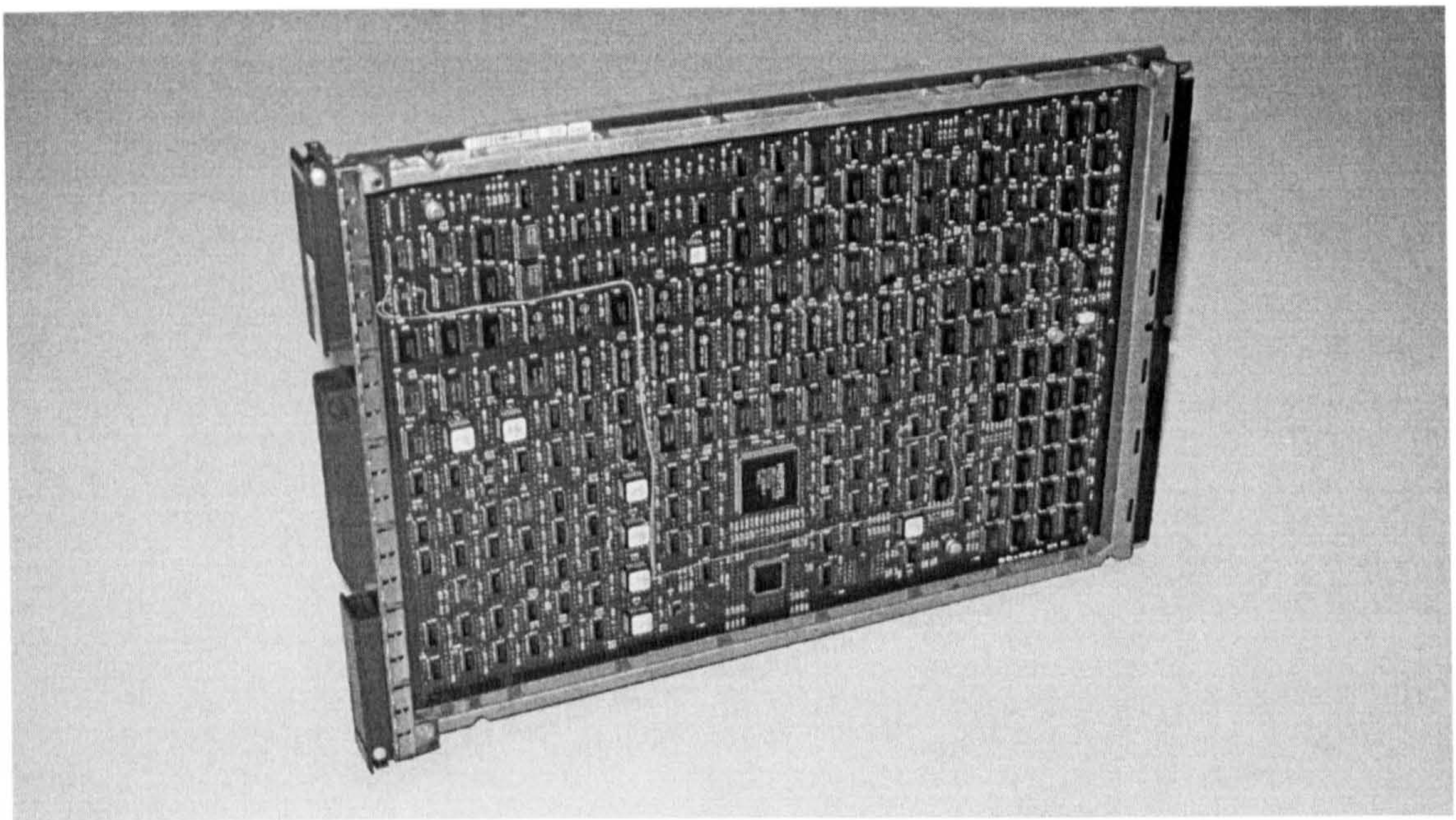
Appendix XVII.

SNSE Images

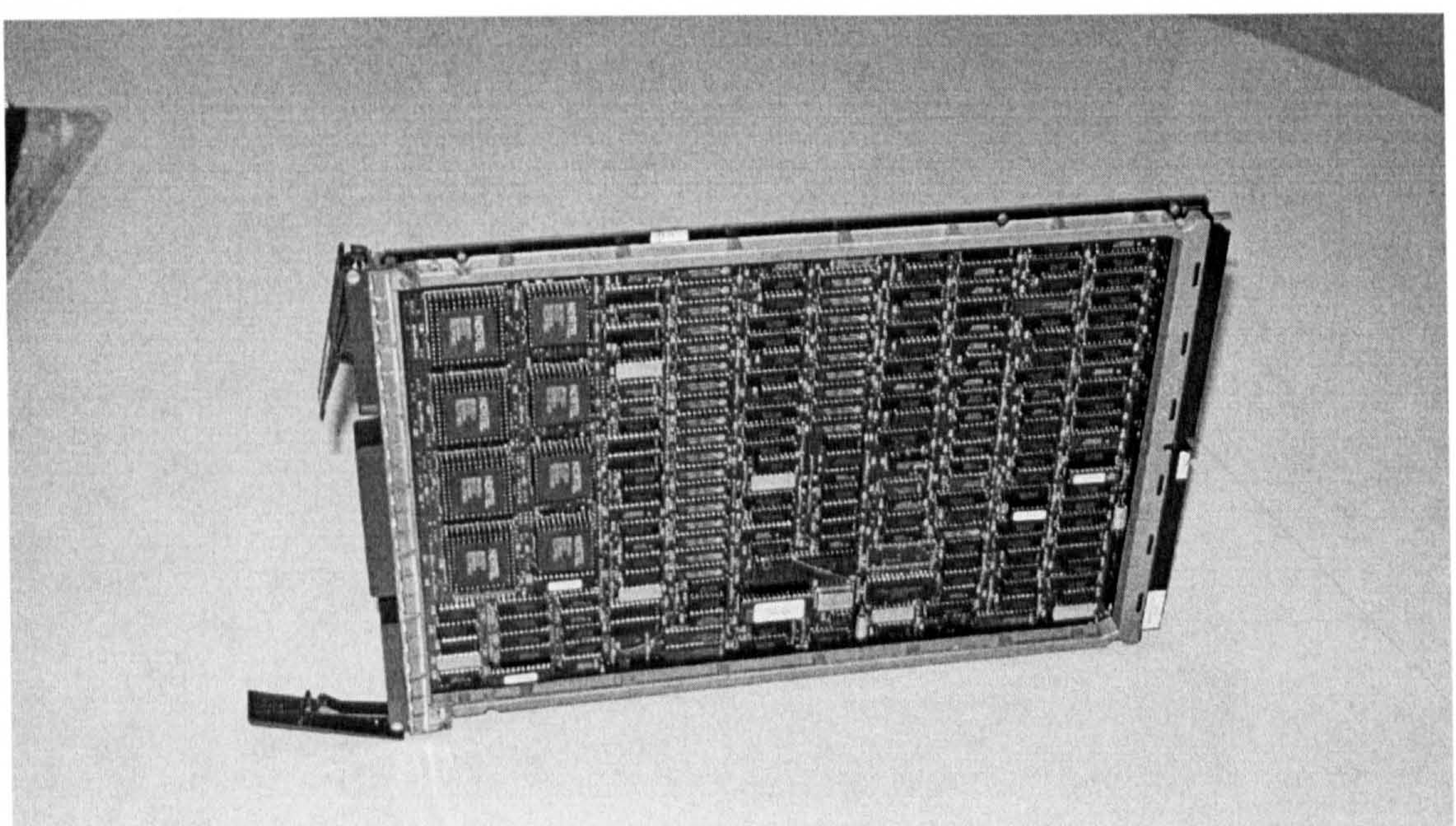
Appendix XVII. Images of SNSE Product



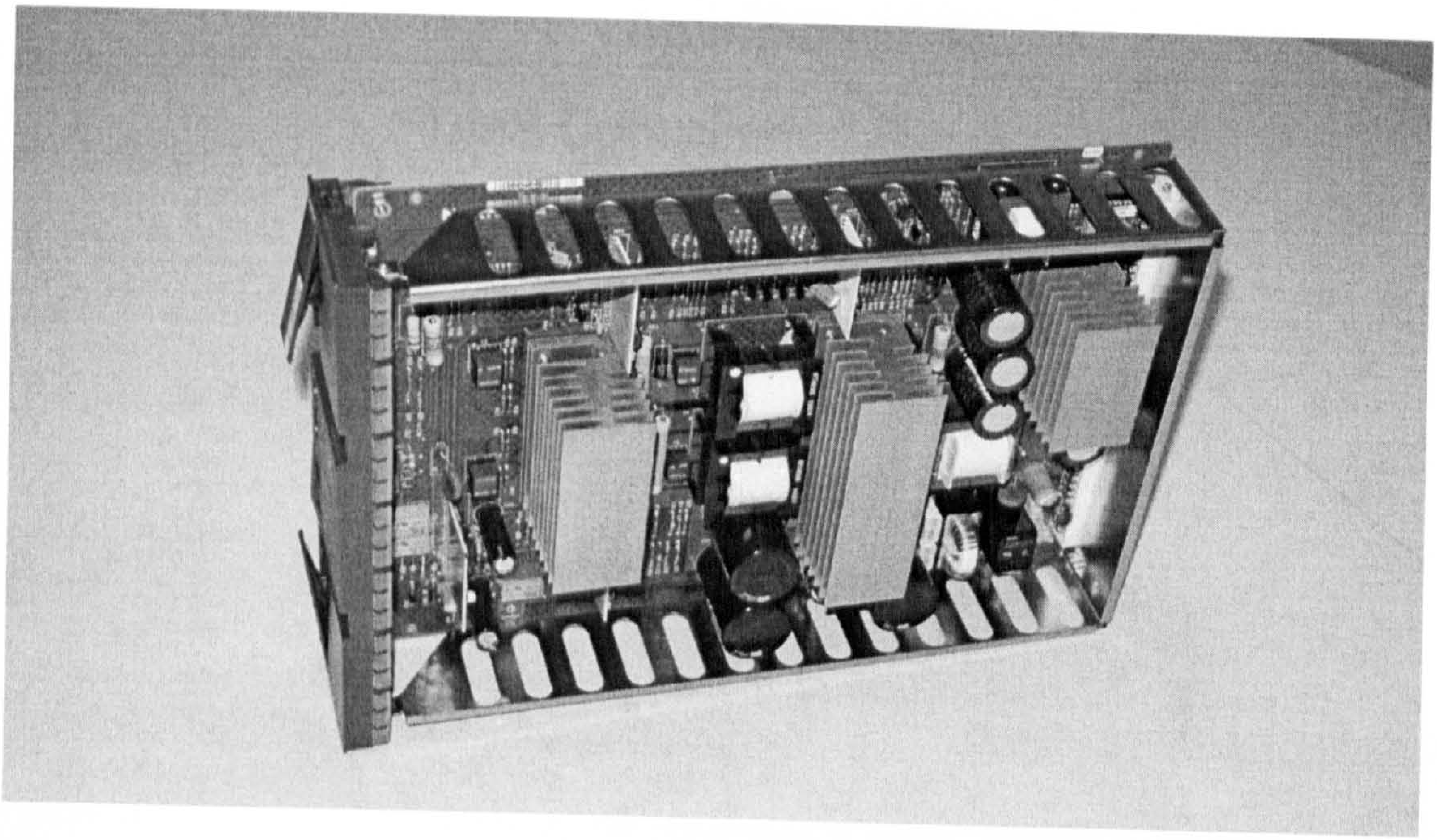
Rear View of SNSE Product with Doors Open



SNSE Circuit Pack NT9X12AD Port Card with Parity



SNSE Circuit Pack NT9X17AD MS4 Port Card



SNSE Circuit Pack NT9X91AC GLOBAL +5/+12V POWER CONVERTER

Appendix XVIII.

DMS Compliance Study Report

Appendix XVIII Extract from DMS Compliance Study Report (Nortel Networks, 1999d)

Hazardous material data was collected through the use of an Excel spreadsheet [1] developed by Carl Mead, Doctorate Research Student, NSPaN Harlow. Data was also collected through partSMart e.g. component finishes, and a 1995 "average" component data source (TemaNord. 1995:554). See Reference Section for further details.

Of the eleven suppliers directly contacted for hazardous material information;

- Only three suppliers (Raychem, Framatome, National Semiconductors) responded with complete data in the excel format provided,
- One supplier (Texas Instruments) responded with detailed hazardous material data and a hazardous material declaration in the company format,
- One supplier (Mayville Metals) confirmed verbally the use of chromium finish 289A on metal products,
- One supplier (AVX) did not want to complete the spreadsheet as a similar one had been finished for Nortel in the past and stated that the old information could be reused,
- One supplier (Aavid) was not able to obtain the hazardous material information due to the lack of availability of such data within the organization,
- Four suppliers did not respond to the hazardous material request or attempts to contact them, and
- One supplier (Sanmina) could not locate the component or part number and felt that they no longer supplied this part due to divestiture of a Nortel facility.

The following Table 2.1 is a list of components selected from common hardware sub assemblies across DMS equipment; NTRX30CA, NT9X01JB, NT9X01MB, NT9X05AC, NTRX31CA and NT9X70BB used to in the attempt to gather hazardous material data.

Most major production commodities were part of the data collection exercise including capacitor, microcircuit, resistor, connector, heatsink, diode, fuse and filter.

Table 2.1 Detailed Hazardous Material Data

CPC	Description	# used	From Assembly	Product Name	Supplier	Materials Covered by 3rd Draft WEEE Directive: Pb	Hg	Cd	Cr	PBB	PBDE	Other Materials
A0378587	Capacitor, CER, CHIP	5	NT9X26DB	Brisc RTIF Circuit Pack	AVX	X						Ni, Ceramic
A0328995	Cap, Cer, Chip 100 ONF	69	NT9X26DB	Brisc RTIF Circuit Pack	AVX	X						Ni, Ceramic
A0322324	IC FTTL Dual FF D	2	NT9X26DB	Brisc RTIF Circuit Pack	Texas Instruments							Si, Br /Sb oxide, Cu, Ni, Ag, Iron, Zn, Pd, P
A0296797	Res Fim SMT	7	NT9X26DB	Brisc RTIF Circuit Pack	AVX							Ni, Cu, Ag, Au, Ceramic
P0661459	Screw Mach. Hex Washer	4	NT9X31AB	Global +5V Power Convertor	Federal Screw Products				X			289A finish , steel low carbon grade
A0329721	Heat sink	1	NT9X31AB	Global +5V Power Convertor	Aavid							**Not able to provide data**
A0636546	Capacitor, Al, AX 0.01UF	7	NT9X31AB	Global +5V Power Convertor	Nichicon							**No data received**
P0675223	Rear Faceplate	1	NT9X19BA	Filler Paddleboard CP	Internal							Ni/Cu Finish, Bfrs, PC (lexan)
P0676546	Rear latch	1	NT9X19BA	Filler Paddleboard CP	Internal							Ultem 1010 (polythermide resin)
P0703914	Faceplate EMI Finger	7	NT9X19BA	Filler Paddleboard CP	Instrument Specialties							Be, Cu
B0238763	C42 Cabinet Mechanical	1	NT995BA	C42 Cabinet Mechanical Assembly	Mayville Metal / RTP				X			289A finish
A0361583	Conn D Sub Array 0.109	4	NT9X0182	Message Switch	Framatome Connectors	X						Ni, Alloy 510, Bfrs
R0107765	Plastic Heat Shrink	1	NT9X0182	Message Switch	Raychem Corp							Polyolefin,
A0263691	IC linear Dual Comprtr	3	NT9X54AC	Stratum 1 External Clock Interface CP	National SemiConductor	X						As, Bfrs, Plastic, Cu, SiO2 , Sb, Su, Ag, Sn
A0263018	Resistor Film 3570.00 OHMS	1	NT9X54AC	Stratum 1 External Clock Interface CP	Vishay				X			**Ag, Ni, Cu, Au, Ceramic, or glass**
A0270881	Fuse Fast AX 10A 125V	1	NT9X53AC	DMS Bus System Clock CP	Littelfuse Inc							Ni, Cu,
P0682710	Semi-Tubular Rivet oval	10	NT9X53AC	DMS Bus System Clock CP	Process Producys Ltd				X			1842 finish
P0691810	Gup Screw Slotted Pan	1	NT9X53AC	DMS Bus System Clock CP	Process Products Ltd				X			Al
A0324156	Conn Norcon, RT recept	1	NT9X14DB	Memory 24 Meg Ckt Pack	Framatome Connectors	X						Ni, Alloy 510, Bfrs
A0271735	Resistor,Film 13.00 OHMS	12	NT9X14DB	Memory 24 Meg Ckt Pack	Vishay				X			Ni, Bfrs
A0287316	IC FTTL Dual NAND 4-IN	1	NT9X14DB	Memory 24 Meg Ckt Pack	Texas Instruments							Si, Br/sb oxide, Cu, Iron, Zn, Ni, P, Pd,
A0329595	Microcircuit	3	NT9X14DB	Memory 24 Meg Ckt Pack	Texas Instruments							Si, Br/Sb oxide, Cu, Iron, An, Ni, P, Pd
A0277530	Diode Zener	2	NT9X26AB	Remote Terminal Interface CP	Fairchild							**Si, Ge**
A0264670	IC Intfc Quad Driver EIA	1	NT9X26AB	Remote Terminal Interface CP	Texas Instruments							Si, Br/ Sb oxide, Cu, Iron, Zn, Ni, P, Pd, Si
A0271689	Resistor Film 100.00 OHMS	2	NT9X26AB	Remote Terminal Interface CP	Bradford Electronics				X			**Au, Ag, Cu, Ni, Ceramic or glass**
B0223499	E-Core Frame Sup. Panel	1	NT9X03AA	Core FSP	Sanmina							No longer supplying this part
P099P855	Rivet, matl Code =A	2	NTRX43AA	Fuse Module	Process Products				X			Al, 1842 Finish

Ag	Silver	Al	Aluminum
As	Arsenic	Br	Bromine
Bfrs	Brominated Flame Retardants	Cu	Copper
P	Phosphorou s	Pd	Palladium
PVC	Poly Vinyl Chloride	Ni	Nickel
Sb	Antimony	Si	Silic

LEGEND

Red Actual Data
Green Average Data

If you would be a real seeker after truth, it is necessary that at least once in your life you doubt, as far as possible, all things.

Rene Descartes