Faculdade de Engenharia da Universidade do Porto

Mestrado Integrado em Engenharia Informática e Computação

ERP and System Integration
na Qimonda Portugal S.A.

Relatório do Projecto Curricular do MIEIC 2007/2008

João Manuel Curralo Mourinho

Orientador na FEUP: Prof. Teresa Galvão Dias

Orientador na Qimonda Portugal S.A.: Eng. Nuno Felino

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To my parents who always supported me and relentlessly fought to help me,
to my sister Rita who has always been the family next to me along all the course
to all my friends, who were my happiness,
and to God, to whom i owe everything.

Summary

Accordingly to the plan of studies of the "Mestrado Integrado em Engenharia Informática e Computação", course of the Faculty of Engineering of the University of Porto (FEUP), a curricular project took place at the second semester of the fifth year of the course. This project was developed at the portuguese industrial facility of the multinational company Qimonda Portugal S.A, a semiconductor manufacturer, installed in Vila do Conde.

The main objective of this project was to study in detail the Customer Returns process at Qimonda (supported by the Customer Return Memory department in Dresden, Germany) and the underlying IT applications that support it, in order to be able to perform a creative investigation work. With that work done, the student should dissert and document in detail the possibilities of integration and improvement. This would require not only a critical and pro-active approach but also a close cooperation with all the people involved in the process. A theoretical and critical work has to be done in order to evaluate all the possibilities of integration/evolution/shutdown of actual IT tools, weighting the advantages, disadvantages and feasibility of each possibility in the view of several different perspectives, having in account not only the Customer Returns process itself, but also a broader Quality Management scope within Qimonda.

In the extent of these topics, the project was called "ERP and System Integration", and it is expected to become one of the bases of the next Quality Management IT improvement plan for the next years, with the purpose of reducing waste, increase efficiency within all the quality processes of Qimonda. The implementation of this plan will lead to gains in data integration, productivity, and response time thus increasing Qimonda's quality rating by its customers and generating competitive advantages in fast changing business world.

In parallel with the development of the project, special attention was given to the communication, human and organizational factors, as this project was developed within a global scale, which implied collaboration with people of different realities and cultures. From the beginning, it was considered that one of the key elements for the success of this project was the involvement and tight cooperation of all the people who were relevant to it. Human factors were always weighted in all the discussed solutions (example: reaction to change and management).

Acknowledgements

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[1] *Mestrado Integrado em Engenharia Informática e Computação*
[2] *Faculdade de Engenharia da Universidade do Porto*
[3] *Qimonda S.A.. Portugal – Information Technologies – Product Automation – Analysis Solutions,*

Terms and abbreviations

ADV – Advantest

APT – Application Test

CLM – Customer Logistics Management

CR – Customer Returns

CRI – Customer Returns Improvement

CRM – Customer Returns Memory

CS – Customer Sales

DC – Distribution Center

ERP – Enterprise Resource Planning

FAB – Semiconductor production software

FAE – Field Application Engineer

GCT – Global Containment Team

IT – Information Technology

MRP – Material Requirement Planning

MRP2 – Manufacturing Resource Planning

QM – Quality Management

QMR – Quarantine Material Request

QNA – Qimonda North America

RDC – Restrictions on Delivery to Customers

RMA – Return Material Authorization

SAP MM – Material Management module of SAP

SAP QM – Quality Management module of SAP

SAP SD – Sales and Distribution module of SAP

SOX – Sarbanes-Oxley Act

SPI – Special Product Identification

SRD – Selective Release for Delivery

TAT – Turn Around Time

VMI – Visual Mechanic Inspection

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1   Introduction

This chapter briefly describes the background of this project. Afterwards a presentation of the project together with its future significance in the processes of the enterprise will be made. An overview about the way this project was developed and the report structure is also provided.

1.1   The project

According to the plan of studies of the MIEIC course of the Faculty of Engineering of the University of Porto that the student is currently following, the curricular project was developed at the first semester of the fifth year.

The project development took place at an external institution named Qimonda Portugal S.A, (as the result of a previous selection and agreement), for the period of five months. The project done was under the supervision of a FEUP Professor (Professor Teresa Galvão Dias) and Eng. Nuno Felino was the project leader within the external institution.

The proposal of the project, named "ERP and System Integration", focused on the integration of the procedures and IT applications that support the Customer Returns process, in order to establish the bases for an improvement roadmap for the Quality Management processes and applications.

The objective of this project was not only to initiate a deep analysis of the processes and IT solutions currently in use in terms of data flow, architecture and structure, but also to perform a creative research work, evaluating every detected hypothetic improvement. By making a risk/benefit assessment of those improvements, it would be possible to support further decisions of the responsible people within Qimonda.

In concrete terms, the development of the project consisted at a first phase in the study of the Customer Returns process executed worldwide, of the departments and collaborators which support it (ex: Customer Returns Memories department), and in the analysis of the software applications which control the process (ex: SAP R/3 *Enterprise Resource Planning*).

It was found that the process was quite optimized, although it could suffer some improvements. The exact opposite happened with the software applications: there was lack of integration between them and some of them did not comply with the processes itself. They were generating waste in several ways (delays, user effort, consumption and underload of resources, replicated and inconsistent data) and causing the process to change itself (and become less efficient and streamlined) to fit the applications. These were the symptoms of the lack of integration between each application and between the applications and the processes. This turned the Customer Returns process less efficient, more delayed and resource consuming, less straightforward and consequently not compliant with the concepts of the modern "*lean manufacturing*" paradigm.

In a second phase the possible solutions were investigated, planned, discussed, compared and for each of them a feasibility study and a risk/benefit assessment according to several different perspectives (human factors, financial factors, scheduling factors, etc) was made. The objective of the project was not to reach any conclusion about the further decisions. Instead of it, the goal was to build a decision support basis for the further implementation of the possible improvement solutions.

All the possible solutions were presented and discussed with the business client (by telephone conferencing, chat, emails, file sharing) since from the beginning it was clear that only a close cooperation with the clients would assure the success of this project.

The sequence of the development of the project closely reflects its specification, which was very ambitious and motivating, having in consideration the short deadlines and objectives.

Along the development of the project, the progress was continuously reported to the responsible people within Qimonda and FEUP. Special attention was given to the documentation organization, as two sites were used to make its storage and publication: one at Qimonda's intranet called *Qshare* and the other one at the internet, available only to FEUP Coordinator and relevant FEUP professors. All the documentation produced was available to all the people related to this project.

1.2   ERP and System Integration

ERP – Enterprise Resource Planning

According to some authors (Rashid et al., 2002) the roots of the modern ERP systems can be traced back to forty years ago, when the first MRP[1] were developed. Those systems were only focused on the production line, manufacturing and inventory control. Their purpose was to plan and control the shop-floor operations by managing the material requirements plan. Nevertheless, the companies had to have other information systems in order to manage other enterprise activity areas such as financials, human resources, sales and distribution.

With the popularization of the computer networks, the MRP systems evolved to the MRP2[2] packaged systems which consisted in several communicating subsystems. Each subsystem was an independent entity responsible for the management of some activity area (ex: Sales and distribution, production, etc). Those systems could be already named ERP, by their wide activity range. Nevertheless that term was only recognized publicly after the release of the R/2 software by a German enterprise called SAP[3] in the year of 1975.

The ERP systems evolved gradually and their popularity soared in the nineties, partially due to the massification of the computer networks and the dissemination of the low

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[1] Material Requeriments Planning

[2] Manufacturing production systems – "2" by opposition to "MRP" alone

[3] *System Analyse and Programmentwicklung*

cost client-server architectures. At this time ERPs were complete packages of several modules tightly integrated, allowing an efficient data flow between all the activities of an enterprise. Nowadays, almost all the companies with a respectable dimension have an ERP supporting its activities, as they can support virtually all the activities of a company.

A modern ERP is an integrated information system that supports practically all the enterprise business activities. This means there is a central database for every module that may allow, for example, that a defect product detected at the supply chain may be tracked and not shipped to the customer by the sales department as information is available in real time for all modules. An ERP allows a complete view on the processes and data flow inside a company.

According to an internet source (Wikipedia, 03.03.2008) ERP implementation can bring several advantages:

- Best practices: ERP systems are designed to replicate the best practices found in the industry, the most efficient and the most productive;
- Integration: all functionalities share a common database, there is no need of interfaces and data conversions;
- Cost reduction and process optimization, leading to reduced lead times;
- Support decision making.

Some of these advantages may be subject of discussion as it is not straightforward to assess their validity. But ERPs also bring some disadvantages:

- The use of an ERP doesn't mean the enterprise processes are truly integrated;
- ERP vendor dependency ;
- Customization of the ERP software is limited, causing the "enterprise to adapt to the ERP", and not the inverse;
- Implementation, maintenance and upgrade costs make many people skeptic about advantageous cost/benefit.

Qimonda followed the trend by implementing an ERP. Qimonda's ERP is the *SAP R/3 Enterprise*, and it was one of the concrete objects of study of this project. Since its implementation, its activity range has being continuously extended to a growing number of processes and is currently the most important information system within Qimonda.

System Integration

Quoting an internet source (Wikipedia, 04.03.2008), system integration is "*the bringing together of the component subsystems into one system and ensuring that the*

subsystems function together as a system." This task requires, from the person who performs it *"a broad range of skills and is likely to be defined by a breadth of knowledge rather than a depth of knowledge. These skills are likely to include software and hardware engineering, interface protocols, and general problem solving skills. It is likely that the problems to be solved have not been solved before except in the broadest sense. They are likely to include new and challenging problems with an input from a broad range of engineers where the System Integration engineer 'pulls it all together'.*"

This was precisely the backbone of the whole project, both in IT[1] and process perspectives: to assess, plan and discuss the integration and optimization of a set of processes and their IT support applications.

Nowadays many companies have ERPs supporting their business processes. Nevertheless there are areas that are not covered by the ERP functionalities, due to several reasons: these areas are supported by legacy or critical applications, the ERP is not flexible enough to support them, or the costs involved may be too high. In addition, there may be a group of organizational constraints that may lead to the lack of integration between the processes, their support applications and the ERP used by the company.

Evaluating all the possibilities of improvement is a fundamental work and involves their analysis by several viewpoints in order to serve as a valuable foundation for decision-making. And it is precisely in this context that this project took place.

1.3   Organization and themes of this report

The present document is organized as follows: this introduction chapter which presents not only the proposal and the context of the project but also its underlying concepts and motivation.

The detailed analysis of the current processes, data flows and software applications comes into view in the second chapter. First the institution where this project took place and the involved departments are described, then the Customer Returns process and the related IT applications are exposed and discussed. Finally a summary of the processes and applications is provided.

In the third chapter some general considerations which guided the improvement detection and solution development are explained as well as the diagnosis of the problems detected and the solutions developed. Their discussion and evaluation are also presented.

All the relevant conclusions of the work executed along the project are stated in the fourth and last chapter. The challenges faced throughout its development are described. A window is left open for the possible developments to implement in the future.

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[1] Information Technology

2   Analysis of Processes and Applications

This chapter starts with the description of the entrepreneurial background where it took place, by making a presentation of Qimonda, and then it tells more about the Qimonda's department which supports the process of the Customer Returns. After that the Customer Returns process and its underlying IT applications state of the art are explained.

The chapter ends with a summary integrated view with both the actual customer return processes and subprocesses and their IT support applications.

2.1   The Project's Institutional Environment

2.1.1   The institution - *Qimonda*

This project took place inside Qimonda, one of the world leader companies in the manufacturing of DRAM[1] products, according to an internet source (The Inquirer, 10.03.2008).

Qimonda is a company which produces integrated circuits, more precisely the ones that are used for information storage: memory chips. These products are used in several types of devices: computers, mobile phones, graphic cards, videogames, etc.

The massification of the use of the technologies and globalization drove Qimonda to have a worldwide presence. Furthermore, the global distribution of Qimonda is also related with the need of being close to their customers, because this proximity is a key factor for the design of efficient solutions tailored to fit the needs of its customers.

2.1.2   Qimonda Organization

Qimonda is a multinational company, and so it is distributed among several countries and continents, as shown in the figure 1.

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[1] *Dynamic random access memory* (DRAM) is a kind of random access memory which stores each bit of information in an individual capacitor inside an integrated circuit. As the capacitors gradually lose their current, the information is erased if memory isn't "refreshed", i.e. if capacitors are not recharged periodically. It is precisely due to this reason that this memory is called "dynamic", by opposition to the static memories which don't need to be refreshed.

Figure 1: Qimonda Global sites

This project has been developed at the "Porto" site, shown in the figure 1. As it can be seen, the Porto site contains a *backend* factory which receives the integrated circuits in *"waffers"* [1] (figure 2), which are produced in the *frontend* sites, and makes the final assembly of the components and the correspondent tests which lead to the final product. This process is described in the appendix 1.

Figure 2: Silicon waffer (left) and final DRAM module made by Qimonda (right).

Porto site also contains an R&D center which contains the competence center *Information Technologies*, and the competence center *High Speed Test* of memory testing.

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[1] *Silicon rounded bases containing integrated circuits(Waffer)*

2.1.3 The IT department

The IT department (*Information Technologies*), in which the student was integrated, is one of the fundamental departments in the global structure of the company. Its mission is to be a competent global partner in the support of the business processes, through the constant provision of the services related with the company's business and strategy, designing and developing future technological processes. Its responsibilities are the following ones:

- Support business with all the necessary IT services;

- Exigent management;

- Design and development;

- IT Operation and maintenance;

- Telecommunications;

- Be in compliance with the global IT.

IT department has several sections, from which it is important to emphasize the PA (*Product Automation*), the one where the student was integrated.

2.2 The CRM department

The CRM (Customer Return Memories) department was also an object of study of this project as it is the main responsible for the Customer Returns process execution. It has a core importance in the all the phases of the process and being so, it was fundamental to study the CRM organization, competences and the way it is organized inside Qimonda.

Qimonda Quality Management

Market				
	Computing QAG QM CD	Graphics QAG QM GD	Consumer & Mobile QAG QM CM	AENEON QAG QM AEN

Core Processes & Support					
	Business Excellence	Lean 6 Sigma	Production	Supply Chain	Customer Returns Memories (CRM)

Regions				
	Asia Pacific QAP QM	North America	Japan QJ QM	Europe QE QM
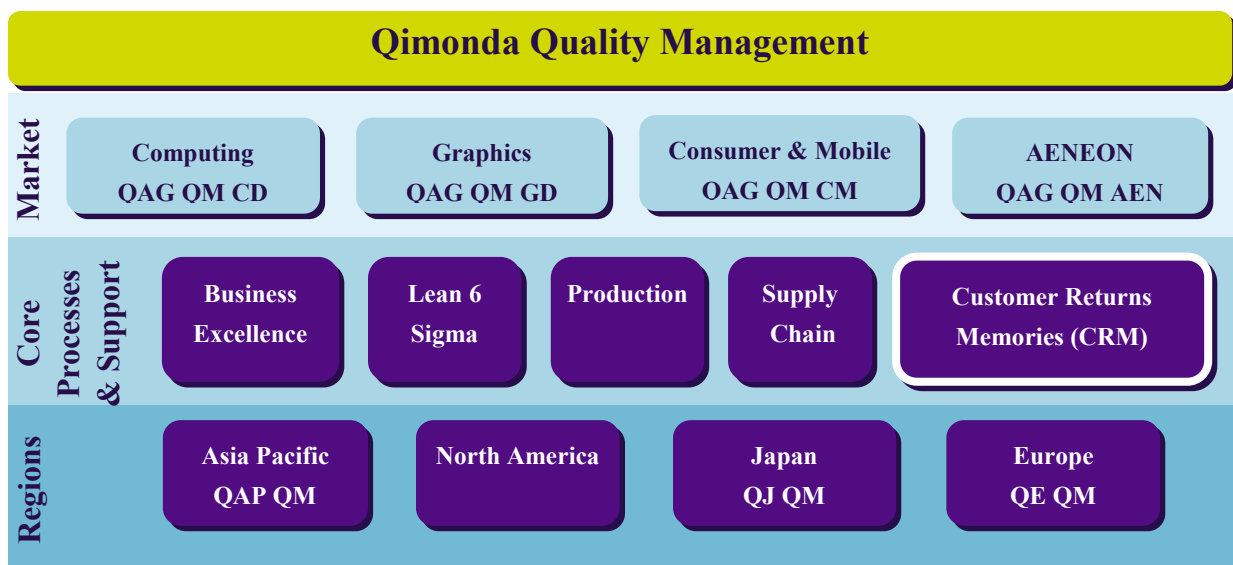
Figure 3: Qimonda Quality Management

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CRM department is located in the Dresden site, Germany and is responsible for several quality processes. It belongs to the PE (Product Engineering) division of Qimonda and comprises a set of sub departments, each one of them with a particular responsibility in the Customer Returns process.

In a broader perspective, CRM can be viewed as part of Qimonda QM (Quality Management), as it supports and enhances quality management core processes operations and support, as shown in figure 3.

As the Customer Returns process is a global quality process, CRM works in close cooperation with other regional quality departments. These departments play a fundamental role in all the Quality Management activities.

CRM mission is to support the CR process through the use of its competences and resources. It has a vital importance also in the Complaint Management process, as CR is a part of it. But CRM has a broader responsibility as part of Qimonda Quality Management: it supports the final steps of the supply chain that are related with the customer (figure 4).

At the final step of the supply chain, the product reaches the customer. Sometimes the product does not meet his expectations so he complains and opts to return it. The first response line is supported by the CLM (Customer Logistics Management) which then sends the defect items to be analyzed by the CRM. With this analysis, CRM may propose changes backwards in the supply chain. It can cause supplier, manufacturing or even distribution changes, if they find that the root cause of the problem can be eliminated by implementing those changes. CRM can also trigger containment actions, (ex: sales exclusions), which will directly involve the DCs (Distribution Centers) or the retailers (logistics).
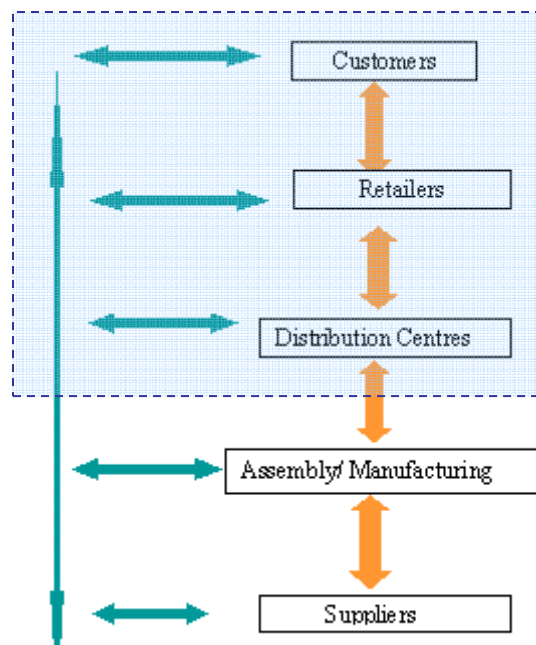
Figure 4: CRM department range of action within supply chain

The shop floor activity can be also changed by CRM analysis, and so it's easy to understand that CRM has an essential role in the quality management, as a potential trigger of

many quality improvement measures which will dynamically affect all the supply and production chain (and the product development as well).

2.3   The Customer Returns Process

The Customer Returns is a phased and complex process which has the aim of solving the problems which lead to the return of the products, and provide correct feedback to the complainer parties. It was process object of study of this project.

It is also a quality process: it has the aim of increase the perceived quality by Qimonda customers, through constant product improvement, investigation and solution of problems as fastest as possible. The company values also apply to this process - mainly the "fast". In a simplistic way, it can be said that the objective of Qimonda is to produce goods whose quality will be evaluated by the customer. If the goods do not have the projected quality, it is because the whole quality management is not working. So the CR is a reliable barometer of Qimonda quality processes. But it is not just a monitor: it is a driver of changes and quality improvement, as it can provide clues and measures to be adopted in the whole supply chain and value chain.

If on one hand Customer Returns process can be viewed as the last step in the supply chain, on the other hand it influences the whole chain backwards and all the quality management landscape as well. It influences the production as it may force new production procedures (as containment or preventive measures), it influences the supply chain by forcing the change of suppliers/storage due to quality issues, it influences the sales as it may promptly implement sales exclusion / special shipments and it influences the R&D as the knowledge obtained may be useful to improve quality of future products.

The Customer Returns belongs to a more general process: the Complaint Management. When a delivered product doesn't meet the specification, the customer who acquired it will complain. The CR process begins if there is defect material returned by the customer, and its management and execution is done by the CRM department. This process is show in figure 5.

When the Customer Returns process begins, items are registered together with the complaint, and they will pass through the technical verification process. The defects found will lead to the classification (i.e. Categorization) of the failure.
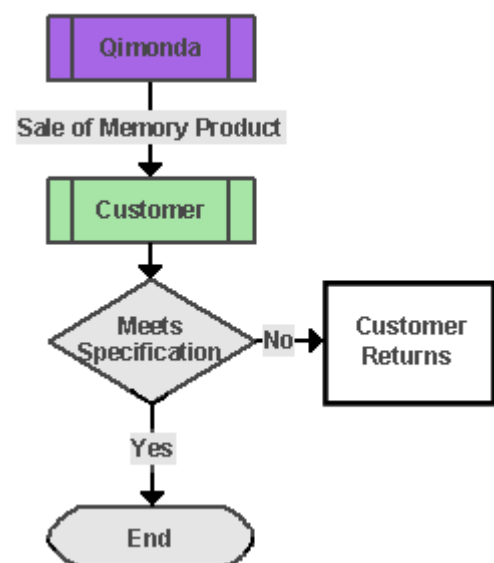
Figure 5: Start of the CR Process

This will be useful to assess the corrective actions to implement, in order to improve quality. When the investigation and assessment is concluded, a report has to be prepared and sent to the customer. The process is illustrated in figure 6.
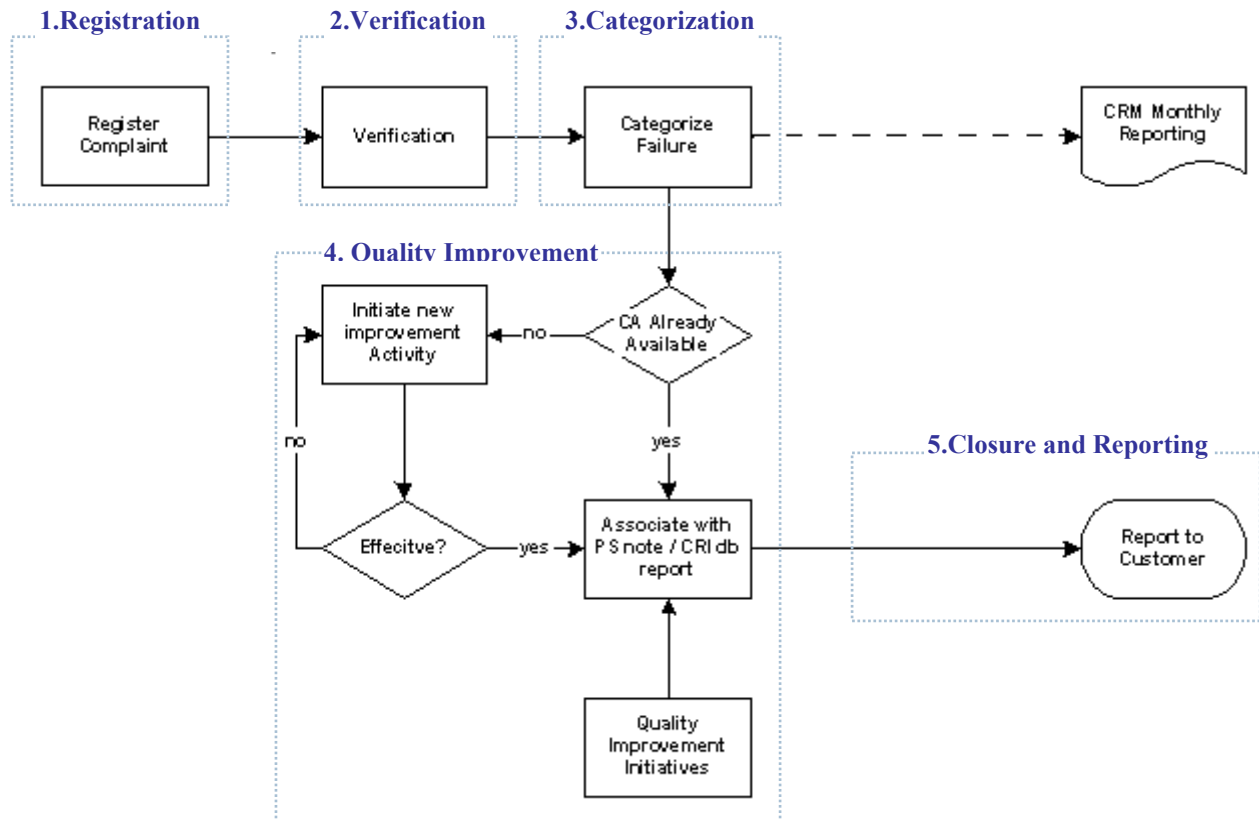
Figure 6: The Customer Returns process and its subprocesses

As shown in figure 6, the Customer Returns process consists of five sequential phases, also called *sub processes*:

- Phase I – Registration
- Phase II – Verification
- Phase III – Categorization
- Phase IV – Quality Improvement Initiatives
- Phase V – Closure and Reporting

2.3.1 Phase I - Registration

As a customer receives malfunctioning goods (DRAM chips, for example), he will complain by asking for refunding, replacement of the malfunctioning goods and/or for an investigation to be executed by Qimonda. In this particular case, the complainer has to

provide all the relevant data, and in most cases has to return the faulty items to Qimonda in order to allow them to be investigated.

Complaint registration is performed in SAP QM and involves customer data, product data, fail information and customer requirements. This information will be processed by SAP and transformed in a complaint structure corresponding to each particular case. After this, the Returns Management Activity is done, and here we may distinguish two cases:

- In Qimonda North America, RMA (Return Material Authorization) web application is used to perform it. User inputs the invoice number which will drive the retrieval of present data from SAP SD[1] (sales order, etc). This data, together with the credit demand and reasons from the customer will be transformed in a RMA case which will be the basis for the credit approval from the responsible parties;

- Outside QNA, the Returns Management Activity is performed in SAP.

At the registration phase other quality management measures, called Containment Actions may be executed. These measures are quick reaction measures to the return (for example, avoid further shipments of defect material), and involve several sections of the supply chain:

- Material Blocking procedures: can be viewed as a direct contention measures, as the objective is to avoid that some materials reach the customers;

- Quarantine procedures: by ensuring that all material of questionable quality is immediately and securely quarantined within production and within the whole supply chain, we avoid that material reaches the customer, thus degrading Qimonda's quality rating and causing further problems and returns. This can be done with the QMR (Quarantine Material Request) tool;

- Restrictions to shipping: the actual shipping destinations can be limited, e.g. some products shall not go to certain customers (Selective Release for Delivery - SRD) or they shall go just to one specific customer (Special Product Identification - SPI).

As Qimonda is a global enterprise, the registration phase is performed mostly by its regional sites, although this process has some particular details next:

1. **Customer complains**

   a. Customer complains about a product and returns the material. Rejected items are shipped to the local QM sites or directly to CRM if it is "key account"[2]. Customer may demand credit, a detailed investigation, replacement etc. (in SAP, these demands are called "requirements").

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[1] Sales and Distribution module

[2] Key account is a term used to define a very important customer

2. **Register complaint**

   a. <u>Common activities</u>: create a new complaint case in SAP QM. Each region has specific complaint managers and each kind of problem has its SAP registering rules;

   b. <u>Specific details</u>: in Qimonda North America (QNA), beside SAP QM, a web application is used to approve the return material cases. In EU (Europe) and AP (Asia/Pacific) this logistic procedure is handled with SAP QM.

3. **Issue Credit**

   a. Occurs in all regions at the time the complaint is registered, except for Europe, where all the items are shipped to CRM Dresden.

4. **Ship Items to CRM**

   a. If customer is a "key account" and/or detailed verification is necessary, items are shipped to CRM;

   b. If this condition doesn't occur, items are verified at each regional QM site, if needed.

5. **CRM Confirmation and analysis**

   a. CRM confirms registration of received items and starts the verification.

It is precisely at the registration phase that the first measures which may affect the supply and production chain can be taken. The integration between the registration phase and the implementation of contention measures is depicted in the Appendix 2. Figure 7 shows the area of effect of the containment actions.
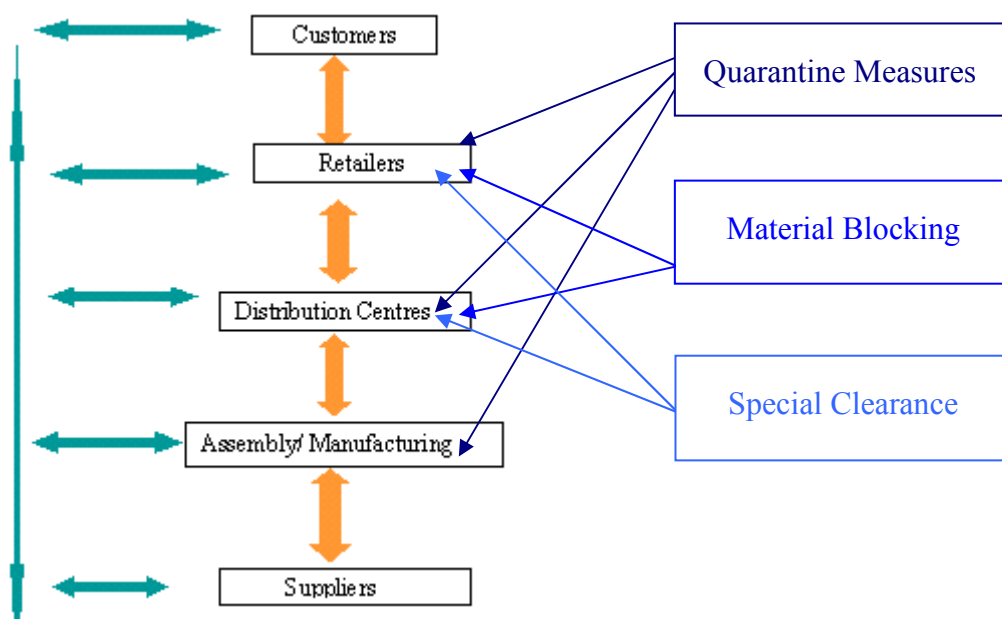
Figure 7: Containment actions influence in the supply chain

The quarantine measures are executed through the QMR application (Quarantine Material Request) and represent the fastest contention measures, as they are intended to take effect as soon as possible by quickly blocking all the relevant lots.

The material blocking are contention measures which do not affect the production (or affect indirectly, if the MRP need to be changed in order to accommodate a decrease in production) and only affect the DC and the shipment of products to customer.

Other containment measures that can be taken are the "Special Clearances". Special Clearance cases are intended to force shipment of an item to a particular customer. They have the highest precedence level, so they can override any other previously established containment actions. As an example, a QMR quarantined lot can be shipped if a special clearance case which refers is approved.

The supply chain can also drive the implementation of contention measures, if, for example, a quality control inside production discovers a defect or malfunction. This is increasingly likely to happen, as with the implementation of the Lean Manufacturing principles (Kotelnikov, 2008) the quality control in production tends to shift from being an extra activity at the end of the production chain to a "built-in" scheme, where each activity center checks the quality of its activities. So containment actions can be virtually triggered by any activity in the production and supply chain. This means that through the containment actions, the supply chain can auto-control its quality and affect all the process till the end customer. Nevertheless it is at the registration phase that the containment actions are most likely to be implemented.

2.3.1.1 Information flow

Inputs

Since this is the first phase of the Customer Returns, the inputs mentioned for the registration are also the inputs of the global Customer Returns process:

- Product specific information;
- Customer data (name, location, etc);
- Notification date;
- Customer requirements;
- Return reason.

Outputs

- SAP QM complaint structure containing all the information about the return. This information will be useful for the next phases of the Customer Returns.
- Containment actions (if necessary)

2.3.2 Phase II - Verification

When defect products arrive to the CRM Dresden, after being registered and shipped, they pass through an inspection and investigation process which aims at finding the root cause. This process is called "Verification" and has two subprocesses: the "standard verification and the "second level verification" (an extended, more detailed verification).

The Standard verification is composed by four sequential sub processes: Visual Mechanical Inspection (VMI), Advantest Test (ADV), Application Test (APT) and Detailed Visual Mechanical inspection. The extended verification is composed by a complex flow of deep investigation activities (Appendix 2). When the failure cause is discovered, the verification process is aborted, a failure signature is obtained and the failure is categorized.

Components (i.e. Chips) and Modules (i.e. finished DRAM cards) have a different verification procedure, which is detailed in the Appendix 2.

The verification algorithm is accomplished through task distribution and management. Tasks are created, assigned to the responsible people within CRM or root cause owner sites. Results of the tasks are obtained in order to accomplish the verification flow and fail assessment. During the verification phase the knowledge about the material fails increases, and when the verification phase ends, this information will be the basis for the categorization phase.

Standard Verification

After registration, CRM evaluates if the problem is logistic. If the problem is logistic, no measurements need to be made, as it is not a technical problem. If the item problem is technical, it is checked if the returned items are modules or components, as they need to follow different testing procedures.

In generic terms, items have to pass through 4 sequential test procedures:

- *Incoming Visual Inspection* to assess mechanical damages;
- *Advantest test* to determine the electrical signature;
- *Application test* (Not for Components) to analyze the lacking test coverage;
- *Detailed Visual Mechanical Inspection* to determine the microscopic image of the failure.

If a fail is discovered, an assessment of the fail is made by a qualified engineer.

Second Level Verification

The second level verification is a technically complex process. Depending on the data gathered at the standard verification, sometimes items are then sent to the responsible site which has produced the fail or has the specific test capabilities needed for that detailed

analysis. According to some CRM collaborators, sometimes in high priority cases those "site detailed analysis" are performed by CRM, in order to save time by eliminating shipping time.

At the end of the full verification process, a fail assessment together with the test results is registered and will be subject to categorization in the next phase.

2.3.2.1 Information flow

Inputs

The information output coming from the registration phase is the input of the analysis phase:

- SAP QM complaint structure;
- Information about the possible containment actions implemented in the registration phase.

Outputs

- A failure signature for the analyzed failure ("assessment") that will be needed for the next phase (Categorization).

2.3.3 Phase III - Categorization

After executing the verification process, the failure signature and the test result data are obtained. With them it is possible to have an overview of the verification process results. This means that the failure signature may be bounded in any category of the fail catalog.

This is a very important step as the categorization of the fails is used to obtain the Pareto analysis, and determine the minimum set measures that should be implemented in order to avoid a significant number of problems. In practice, it is impossible to implement individual corrective actions to each specific root cause of all the particular failures, so the Pareto analysis is of fundamental importance in the quality improvement measures. It is a quality optimization technique that is based on, *"finding the changes that will give the biggest benefits"*, as stated by an internet source (Mindtools, 12.03.2008). Wikipedia also states (Wikipedia ,12.03.2008) "*Pareto analysis is a statistical technique in decision making that is used for selection of a limited number of tasks that produce significant overall effect. It uses the Pareto principle - the idea that by doing 20% of work you can generate 80% of the advantage of doing the entire job. Or in terms of quality improvement, a large majority of problems (80%) are produced by a few key causes (20%)"*. And it is precisely the need to find the key causes that turns the categorization phase into a crucial one.

Categorization is a simple process:

- Together with the failure signature, test data coming from several tests performed at the verification phase is analyzed, and if the problems found fit in one existing category, then failure is categorized. If problems found need a new category, a new fail category has to be created;

- At this time, by having all the input data in the same screen, the operator inserts the categorization value for each categorization level;

- The Pareto analysis is executed;

- Knowing the fail categories and the significant fail causes the Quality Improvement phase is then started.

2.3.3.1   Information flow

Inputs

- Test Data, Lot Data;
- Associated complaint data (coming from SAP notification structure);
- Existing Pareto categories.

Outputs

- A Categorization value for each failure level which will be useful for the next phase of the Customer Returns. Those values are exported to SAP QM.

2.3.4   Phase IV – Quality Improvement Initiatives

After executing the categorization process, corrective (and preventive) actions have to be found in order to eliminate the root cause of the problem. Most of times there are already solutions for the problems found, or the problems are recurrent problems. However, some fails may be detected for the first time, and in these cases investigation work needs to be carried out in order to find solutions for them.

The process starts by confirming if the failure signature is known. If so, there is already a solution for it. If the solution is effective, this process ends here as it is already known how to eliminate the root cause of the problem in an effective way. If the failure signature is not known or the improvement is not effective, a new improvement activity will be initiated at the responsible site. These improvements may also be spontaneous (i.e. not

triggered by the CR process), and may occur at each site. All the improvement information developed is stored in the CRI (Customer Returns Improvement) database to serve as a knowledge basis for future Customer Returns.

2.3.4.1   Information flow

Inputs

The information output coming from the categorization phase is the input of the Quality Improvement phase:

- Failure signature categorization.

Processing

At this time, having all the correct categorization levels, the solutions are searched in the knowledge database to check if there are improvements for the problem. This database contains a knowledge base of reports, pictures and relevant data about known problems and their solutions. Many times is not needed to create new reports as the ones already stored in the knowledge database fit the specific case, so a link is created to the old report.

If there is not any knowledge about the current case, a new report is created. Every new 8d[1] report has to be saved in the database. The spontaneous quality improvement initiatives should be also recorded there.

Outputs

- Mainly 8d reports and a set of measures, results, reports, important knowledge that will be sent to customer and be stored in the knowledge database.

---

[1] The 8d report represents the result of the 8d problem solving methodology (please see Appendix 3 for more details), which goes through several phases, and contains the information relative to each phase. It contains information about the information and identification of the problem, the containment actions that should be taken in order to avoid the propagation and perpetuation of the problem, the root cause (which is obtained after the verification and analysis work), and the corrective and preventive actions which will address and prevent the problem.

2.3.5   Phase V – Closure and Reporting

After finding/building suitable knowledge to the specific problem (8d report, corrective/preventive actions, test data, pictures of the defect found, solutions to implement and instructions to customer), it is time now to close the case. But before doing it, the reports have to be prepared and reviewed, before archiving and sending them to the complaining customer.

The root cause owner (ex: a Frontend, backend site) elaborates an 8d report, which is merged with some possible existing report or information about the failure. CRM department reviews and completes the report then it is sent back to regional QM site that checks whether the report is adequate for customer and reworks it as needed in order to fit the customer specificities. This work has two objectives: fulfill customer expectations by delivering a special customized report and increase company quality perception (not disclosing to customer sensitive information about the fail and its causes).

SAP QM provides the means to insert relevant information to each chapter of the 8d report (and generate it as well). CRI application is also used to build the 8d reports as it is a repository which can include previous 8d reports, presentations, root causes and corrective actions that can be inserted in the actual 8d report. The communication between the people involved is email and "application message exchanging" (ex. task feedback in SAP).

The report is sent to customer and the customer return case is closed.

2.3.5.1   Information flow

Inputs

The information output coming from the Quality Improvement phase is the input of the Closure and Reporting Phase:

- 8d Reports;
- Other relevant data.

Outputs

- Final 8d reports (an example is in the Appendix 4).

2.3.6   Information Flow Overview table

Table 1 shows an overview of the information flow of all the phases of the Customer returns process.

Table 1: Information flows in the Customer Returns process phases

Phase	Inputs	Outputs	Responsibility
Registration	Defect info and Material, customer requirements,	SAP QM Notifications, package shipment	Regional QM and QM CS Sites
Verification	SAP QM Notifications, Package shipment	Failure Signature and test results	CRM Dresden, BE/FE/AE/PRE sites
Categorization	Failure Signature, Test Results, SAP QM Data	Categorization Levels to SAP QM	CRM, QM sites
Quality Improvement	Categorization levels, test results and information	8d Reports and knowledge	CRM, QM sites
Closure	8d Reports	Final 8d Reports	CRM, QM and QM CS sites

2.4   The IT applications

After describing the CRM process as part of a broader QM scene inside the Qimonda and having analyzed the information flows through the previous documents, this section describes the IT applications currently in use which support both those processes and information flows. This description completes the foundations (together with the processes and information flows already described) for extracting valuable knowledge which leaded to further improvements through project.

Quality Management is nowadays supported by software tools which aim to reduce defects in products, reduce TAT (Turn Around Times), avoid repetition of defects and avoid propagation of defects. Qimonda's quality processes are supported by a vast group of software applications, and some of them are in the way to be shutdown, as they don't fit anymore the ever-changing requirements of the Quality Management in a dynamic environment like Qimonda's one.

The Customer Returns process makes use of several applications in order to organize itself. These applications support entirely the process, provide the means to decrease TAT and the integration with other QM systems and processes.

2.4.1 Description of the applications

Table 2 briefly describes each application used in the Customer Returns Process.

Table 2: Description of the applications used in the CR process

Application	Description
SAP QM	SAP is a powerful ERP. It is used in Qimonda as the main Information System. Its QM module supports the CM (Complaint Management) and CR processes, and provides a wide range of functionalities for CR and CM, such notification structure, comprehensive task management and reporting and other document storage and communication.
RMA web portal	RMA stands for "Return Material Authorization" and it is a Web application used just in Qimonda North America to manage the return material authorization. Basically it provides an approval workflow for the responsible persons of the Refunding or customer requests on the Customer Returns.
SRD	Selective Request of Delivery is currently a non-standard SAP transaction which allows the definition of inclusion/exclusion rules for lot shipment to customer.
SPI	SPI (Special Product Identification) is a Web Application inside RDC (Restriction on Delivery to Customer) platform used to report routings of certain finished products to a specific customer, while advising non-shippability of those products to any other customer.
AVL	As part of RDC platform, AVL (Approved Vendor List) is Web application inside RDC used to confirm qualification status of Qimonda products by its customers.
SC	SC is a Lotus Notes application used to implement the Special Clearance Process, which deals with special "non-conforming" shipping requests of products of questionable quality or other with related customer restriction.
QMR	QMR is a Web application used to implement the Quarantine Material Request process, which ensures that all material of questionable quality is immediately and securely quarantined within production and within the whole supply chain in order to guarantee no further escapes to customers.
FAB tools	Fab tools for lot testing, redirection, test result attachment, shop floor activities
Catbrow	Catbrow is an application to categorize the material failure signatures found during the verification process.
CRI	CRI is a Lotus Notes application which serves as a knowledge base for reporting.
ATT	Analysis Tracking Tool is a Web application which provides a set of task distribution, tracking and reporting. Quite useful for managing investigation activities.

For each phase of the CR process, these applications can be classified in "operational" or "analytical" if they are related to the lower level execution of actions (operations) or related to the decision support (tactical planning of the company's strategy), respectively. The table 3 illustrates this classification:

Table 3: The applications classified as operational or analytical

Phase	Operational	Analytical
Registration	SAP QM, RMA	RMA
Verification	SAP QM, FAB tools, ATT	
Categorization	SAP QM	Catbrow
Quality Imp.	SAP QM, MS OFFICE	CRI
Closure	SAP QM, CRI	CRI

Those IT tools may be viewed outside the CR process as belonging to a more general QM landscape. They may support the complaint management, the implementation of containment actions (material blocking, quarantining, and special clearances), acting throughout the whole supply chain, or even supporting the production line and other shop-floor activities, as shown in table 4.

Table 4: The applications used in the CR process classified according to their QM area

QM Area	Applications
Material Blocking	SRD, SPI
Special Clearance	SC
Material Qualification	AVL
Quarantine	QMR
Production Support	FAB tools
Fail Analysis	ATT, SAP QM
QM knowledge Storage	CRI
Fail Categorization	Catbrow
Complaint Management	SAP QM, CRI, ATT. Catbrow

2.4.2   SAP QM

SAP is probably the most used ERP in the world. 2005 forecasts for 2006 (figure 8) point it as having a market share of 43 percent, almost doubling its nearest competitor. It is not surprising that many big companies are moving into SAP. In this context, Qimonda also started to move to SAP by turning it into the main information system, through the integration of the several applications in use. One of the first areas chosen to implement SAP was the Quality Management, more precisely the complaint management. Benefiting from the modular architecture of SAP, Qimonda was able to start implementing the features gradually, progressing along the planned implementation roadmap.

The SAP QM module now supports Qimonda's Complaint Management by being integrated with external applications (and eventually replacing them). SAP QM module also supports partially the Customer Returns process, as it may be considered part (or a specificity) of the complaint management process. But in a higher level, SAP Quality Management is completely

Figure 8: ERP vendor market share forecast by AMR Research (2005)

integrated with every other enterprise processes, namely the supply chain, as it can be viewed in figure 9.

Figure 9: SAP QM functionality is transversal to the supply chain

The quality planning is a cross-disciplinary function, the aim of which is to improve the overall quality of products and processes while reducing total quality-related costs. Hölzer and Schraam (2006) SAP QM provides the following means to support the quality planning:

- A channel for representing the requirements of individual task areas to the quality-management department;

- Quality assurance system;

- Quality inspection methods;

- Incorporation of quality costs into the results improvement strategy.

These features use a particularly large amount of cross-module master data from materials management, production, and other logistics components, reflecting the influence

they have in the supply chain.If solid foundations were laid in quality planning, quality inspection can begin. Inspection lots are generated by material movements, production orders, or deliveries, or are created manually. Inspection lots then undergo quality inspections based on predefined properties. Along with the inspection-lot completion, important information is transferred to the quality info system and the available for quality control.

The quality notification is another area which cannot be seen as a separate process. SAP QM provides the integration of this area with logistics, as the goal of problem notification must be to form a workflow process across several specialist departments. The main task of SAP QM notification system is to handle external and internal complaints in connection with vendors and customers, and to trace problems in the production environment. Qimonda's SAP QM Quality Notifications have been customized to fit its needs. A hierarchy has been set up, with the General Notification (N0) being the "head notification".
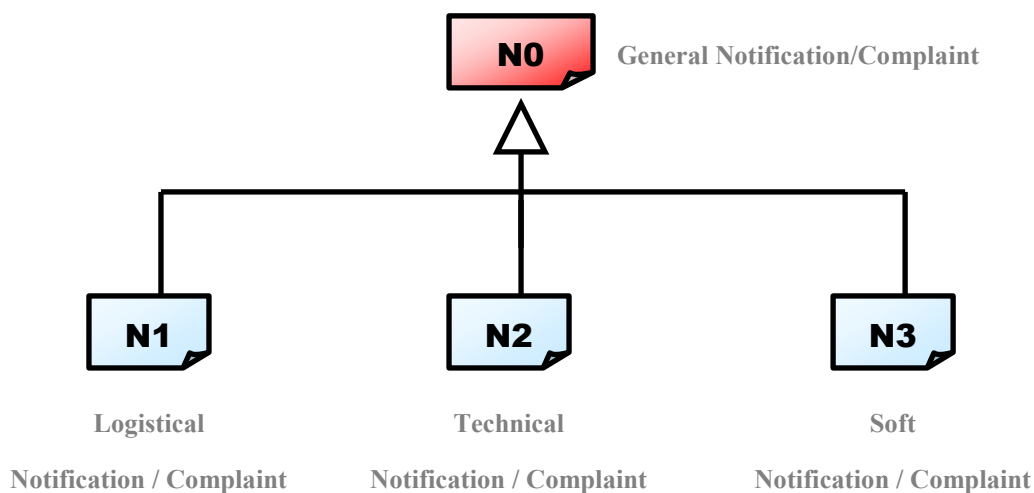
Figure 10: The SAP QM notification Structure

This notification can have several types of subnotifications: the N1, N2 and N3 notifications, which correspond to the logistical complaint, the technical complaint and the soft complaint (see figure 10):

- Logistical complaint: problems with the delivery (packing damage, wrong product, not-in-time delivery) or commercial return;

- Technical: problems with the product itself or inner packing materials;

- Soft: generic problems not product or shipment related.

All these three notifications have a process flow through the execution and distribution of several tasks in order to solve the problems which leaded to their creation.

As it can be concluded, quality management in SAP is a complex and fully integrated process, which has connections to other areas of the business, such as production, materials management, Sales and Deliveries, etc, as it is impossible to implement an effective quality management program without a complete data integration of all the processes within the

supply and production chain. So as SAP QM has a broader scope and its benefits are higher if used to make a complete QM approach at all stages of the supply chain, as nowadays customers do not judge the product quality, but the quality of the vendor relationship as a whole.

2.4.2.1 Functionalities in the CR area

SAP QM provides a solid basis for Customer Returns process, by powering:

- Return/complaint Registration;
- Complaint administration and reporting (status control, several user roles);
- Job assignment (task distribution and feedback gathering) and notification through several means (email, etc);
- Customer Returns task support (shipment of samples, lab analysis, etc);
- List Reporting and Exporting to external applications (Microsoft Excel);
- Qimonda's SAP QM has some enhanced features not found in the standard version (some tasks, workflows, user statuses, communication with external programs, etc).

The registration phase is done almost entirely in SAP QM, analysis tasks can be managed there in a near future (though now they are managed using ATT). Catbrow results are exported to SAP fields in the categorization phase. The quality improvement phase is currently done in CRI but in a near future may be completely done in SAP by using a reworked notification system. The closure and reporting phase is entirely supported in SAP.

2.4.2.2 Data Flows

The data input in the registration phase will be organized into a notification structure of type N0-N1/N2, as described in the complaint management guidelines. If failure analysis or verification is needed, tasks are then executed (not only in SAP, but also in other applications such as ATT) and their results posted. SAP notification data and material is sent to external programs (ex: Catbrow) as needed throughout this process. The Catbrow data is returned to SAP in the categorization phase to the PSI (Part Specific Information) fields, and in the next phases the 8d reports are sent through SAP to customer.

Figure 11 shows the inputs and outputs of SAP QM in all the phases of the Customer Returns, as it is used in every one of them.

Input	Type
Product data	User
Type of complaint	User
Origin of defect	User
Customer data	User
Business Partner	User
Client Reference date	User
Start date	User
Incoming location	User
Required start date	User
Assembly Code	User
Lot Nr	User
Condition	User
Serial number	User
Customer requirements	User

SAP QM (Registration Phase)

Output	Type
Notification Emails	User

Input	Type
Task execution	User

SAP QM (Verification Phase)

Output	Type
Task Distribution	User
Emails	User
Data for ext. App.	Software

Input	Type
Categorization (PSI Fields)	Software

SAP QM (Categorization Phase)

Output	Type
Problem solving	User

Input	Type
8d Report Attachment	User

SAP QM Quality Improvement

Output	Type
Emails	User
Data for CRI	User

Input	Type
8d Final report	User

SAP QM (Closure and Reporting)

Output	Type
Customer 8d Reports	User

Figure 11: Inputs and outputs of SAP QM at the Verification, Categorization, Quality Improvement and Closure and reporting Phases

2.4.2.3 Architecture Summary

SAP R3 architecture consists in a three layer division as figure 12 shows. The presentation layer consists of the client GUI application which shows the interface. Then it communicates with the application layer through the network (intra/internet) with the second layer, the application one, which consists of the ABAP interpreter and the ABAP programs. That layer is connected with the database layer, which consists in a relational database management system, (Oracle, MySQL, etc).
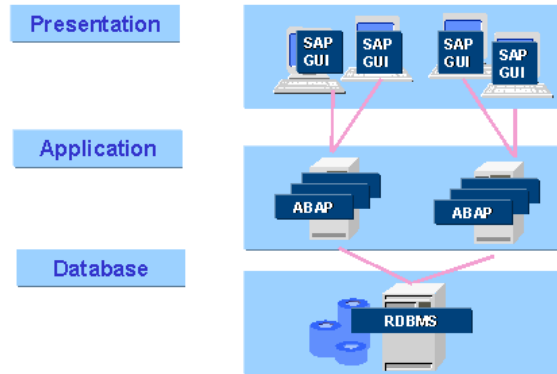
Figure 12: SAP 3-layer Architecture

We can see the current database and support hardware used by Qimonda's SAP R/3 QGI (test system) in figure 13:

Figure 13: Qimonda's QGI system server configuration

2.4.2.4 Interface Summary

Typically, users can access SAP through the standard GUI, nevertheless Qimonda SAP provides a web interface for the creation of the Quality Notifications which makes it easier. Figure 14 illustrates the standard GUI (left) and the WEB GUI (right):
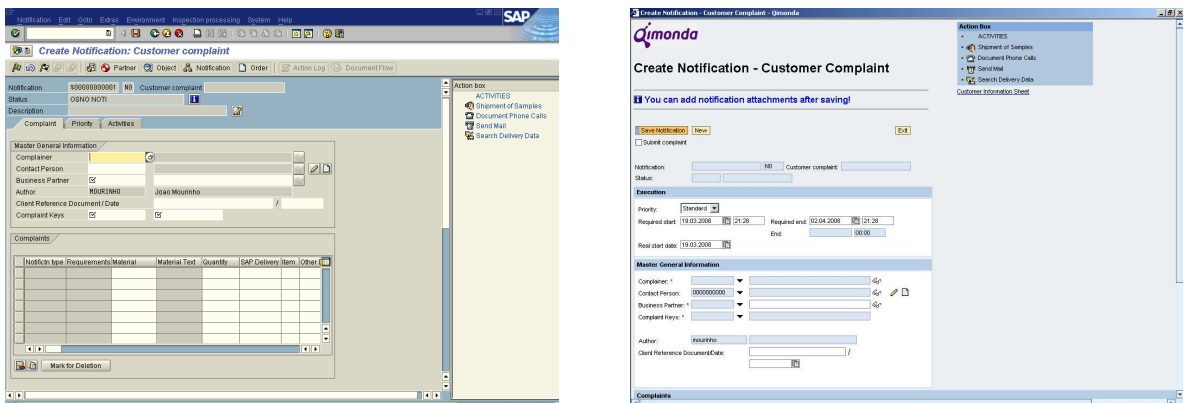
Figure 14: SAP QM client GUI (left) and WEB GUI (right)

2.4.2.5 SWOT analysis

Strengths - SAP is a stable, reliable and scalable system. Its modules are fully integrated and interfaced. It is a real-time system (by opposition to a non-real time or batch system), and allows to have a quick general view on all the processes happening inside a company. It supports big loads of data and it is a modular system. Those characteristics make SAP a formidable ERP. Its QM module works integrated with the material management, SD and supply chain activities in order to effectively implement a quality system. Only one system can handle all the complexity of the tasks of a company.

Weaknesses - SAP R/3 has some particular weaknesses in what concerns to development and updatability costs. By using a closed proprietary development language, it raises the development costs and makes SAP a real budget-consumer when new non-standard improvements are needed. Those improvements may decrease the upgradability of the system to new versions and create incompatibilities. QM module is perfectly integrated with other modules, but is difficult to integrate with external programs which are still in use by Qimonda (ex: Catbrow), due to costs and technical expertise required. However this situation has been changing with the new integration middleware launched by SAP, though it is not as easy as an open-architecture. SAP has not also a very friendly interface, it is difficult to install setup and administrate. Generally speaking, SAP is classified by its users as being "overcomplicated". The interface should benefit of the GUI improvements brought to reality by Microsoft windows and MacOS in order to achieve a higher user acceptance.

Opportunities - SAP represents itself the opportunity: there is an increasing pressure to integrate external applications and functionalities in SAP. SAP is becoming the main information system within Qimonda and is extending its domain to all the activities of the company. Of course this reduces operation costs and complexity. The support staff can be concentrated thus reducing waste.

Threats – The evolution of external applications is a threat to SAP QM.

2.4.3 RMA – Return Material Authorization Web Portal

RMA is a Web application used for managing the authorizations related to the returned material. When a customer returns material, he may ask for credit or replacement. This request has to be approved by the competent staff at Qimonda. This is done through the use of the RMA tool in North America. In all other locations, SAP QM is used for the same purpose. The RMA application allows keeping track of the RMA cases and provides an electronic "proof" of the responsibilities of financial movements involved (approval of the movements). This tool is just being used in Qimonda North America (QNA) and probably accomplishes the Sarbanes-Oxley Act (Commonly named "SOX"), more concretely the

"internal control certifications and assessment", and the "information technology" conditionings (Appendix 5).

When customer decides to return the material, the RMA case is stored in the RMA database and it will go through an automated approval flow which decides the right approval parties. This flow is sequential, which means that the approval requests only go to a higher hierarchy approval party if the lower hierarchy approver has approved the return. The return is only considered approved if all the approver parties agree to approve it.

QNA, after receiving the customer returns and requirements, uses RMA along with SAP QM in the Customer returns registration and SAP SD/GOAL in the information retrieval. SAP is still used for the registration of the notification structure as stated in previous SAP QM description. Still, the approval workflow is executed in RMA, as it has an automated approval workflow.

All the process which involves RMA Web tool and SAP is shown in figure 15 (the diagram is detailed in Appendix 6):

| Return Material Request | RMA Creation | RMA Approval | RMA number sent to Customer | Material Receipt from cutomer | Release credit to customer |
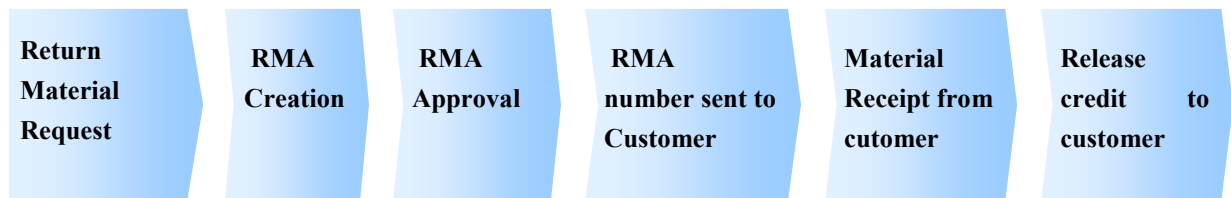
Figure 15: QNA RMA process (inside registration of Customer Returns)

2.4.3.1   Functionalities

RMA provides a set of functionalities which allows the responsible parties to sign the RMA approval (or refuse). Being so, RMA application allows:

- Creating/Editing of RMA cases;
- Managing RMA case approvals by the adequate approver parties (which vary, depending on the value of the credit);
- Define the threshold credit values for the approval responsible parties.

2.4.3.2   Data Flows

Figure 15 shows the inputs and outputs of RMA in the phase of the Customer Returns that it is used.

Input	Type
Invoice Number	User
Customer Data (Name, address, etc) (Ship-to)	SAP
Purchase order nr.	SAP
Invoice Number	SAP
Delivery Number	SAP
Return Order Number	SAP
Requirements	User
Requested action (credit/other)	User
Item nr	SAP
Product type	SAP
Return Reason	User
Total Value	User
Approval	User

RMA WEB PORTAL

(Registration Phase)

Output	Type
Approval	User

Figure 16: Inputs and outputs of RMA web Portal

2.4.3.3   Architecture Summary

As with every ASP applications, RMA has a 3 layer logical structure: Database layer, Business Logic layer and Interface. Its SQL Server database features tables which store the approval data: status, SAP SD data, and there is a special table for email management. User roles are contained in two tables, which contain also the access levels. A table for return reasons also exists. The interface with SAP is made through an R/3 DCOM connector, which is responsible for retrieving SAP data.

2.4.3.4   Interface Summary

Conceptually, RMA interface is a typical ASP application interface, making use of forms and interface controls like text boxes, radio buttons, etc.

The first screen after login user will face is the list of pending RMA cases, classified by their classification status, as shown in figure 17:

- White: RMA in Design;
- Yellow: Pending Approval;

- Green: Approved;
- Red: Rejected.

Figure 17: RMA Web Portal interface example

2.4.3.5   SWOT analysis

Strengths - RMA is a tailored solution, designed for a specific purpose. It is user friendly, simple, provides an efficient way to keep track of the RMA cases in a financial perspective, and provides an automated approval flow.

Weaknesses - Almost all information is imported from SAP so probably the solution could be designed in SAP. It is only used in QNA, not a global solution. It has design flaws which do not allow supporting the approval of the returns as the process specification rules.

Opportunities - With some development, there is the strong conviction that SAP could perform the same functions in a completely integrated way.

Threats - QNA collaborators need to be completely involved in a possible change in order to decrease resistance to change, as RMA is considered very simple and efficient by its users. As it is only used in QNA, budget for integration may be more difficult to obtain.

The following question arises: *"is it worth to integrate a small application like this who is reliable and easily maintainable (has only one person responsible for the support)"*?

2.4.4   SRD – Selective Release of Delivery

SRD was formerly part of the RDC (Restrictions on Delivery to Customers) platform till February 2007, but was then migrated into SAP. It is now a SAP transaction (ZSRD).

Throughout this migration, it became simpler, more focused in its main objective: to define shipping and sales constraints ("rules") of a certain kind of products, according to their client demands. This application makes sure that customers receive what they want, with the requirements they wish. SRD is a contention measure support application.

At the registration process regional sites have to implement containment measures. This may imply stopping the shipment of a defect product to the complaining customer. SRD may be used to set the shipment and sale restrictions, this tool can also serve to implement containment measures (for example, if a lot doesn't meet the quality requirements of the customer, the shipment of that lot to that customer can be avoided)

SRD, like RMA, provides an approval workflow for the SRD rules which define the shipping constraints. Once a SRD rule is created, it may be approved or not. Being so, a SRD rule can have one of the following statuses listed in table 5.

Table 5: Possible SRD rule statuses

Status	Meaning	Observations
New	Document recently created	Automatically set by default when creating a SRD case
Approved	SRD rule approved and active	Approval executed by the editor (responsible person)
Rejected	SRD rule rejected and not active	SRDs having this status can no longer be started
Request Closure	Request Closure of the SRD case when active	Demand executed by the Requester
Closed	Case that was active but has been closed	Closer executed by the editor (responsible person)
Obsolete	SRD case is outdated	System defined

2.4.4.1 Functionalities

SRD has lost some of its functionalities when it was integrated in SAP. Nevertheless, its core features remained functional:

- Creation / Search / report of the restriction rules (export to Excel/Word possible);
- Layout saving (not as complete as previously).

2.4.4.2 Data Flows

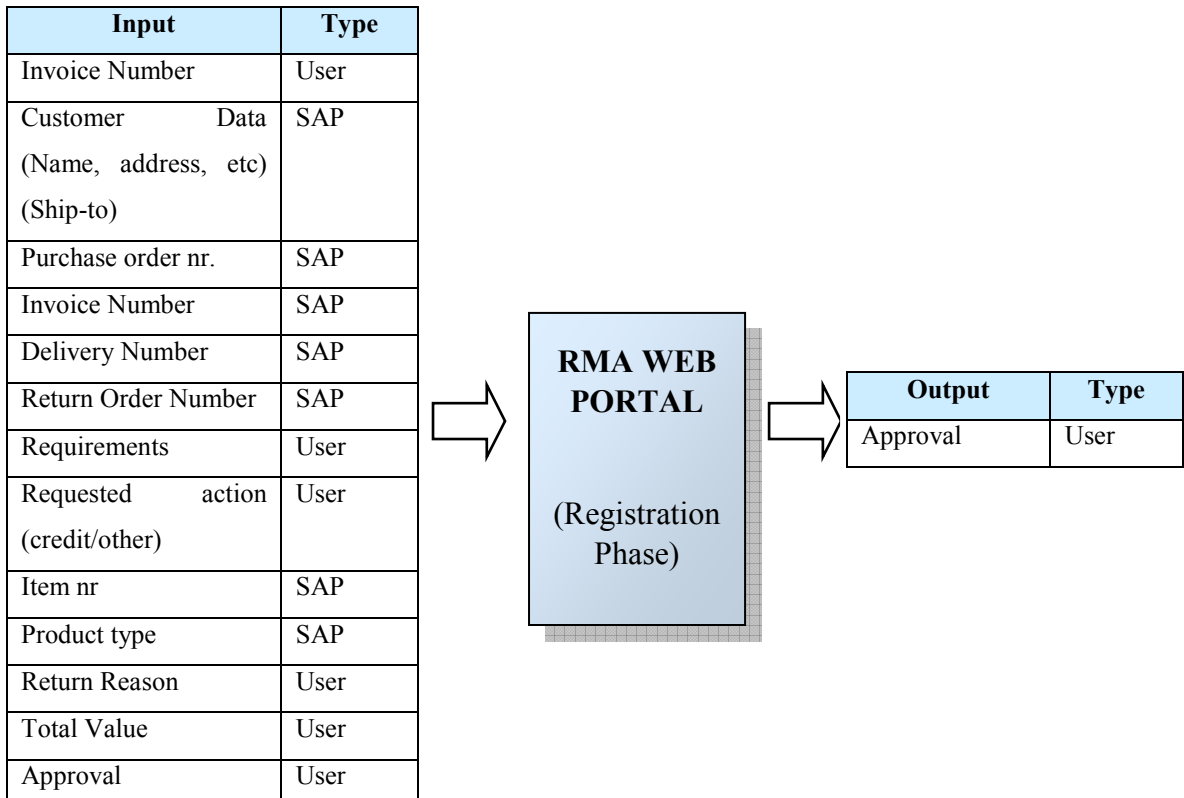Figure 18 shows the inputs and outputs of SRD in the phase of the Customer Returns that it is used.

Input	Type
Number of Customer	User
Product details(Product line, product name, product group business group , main product group)	User
Finished product technical details: step, version, "green", generation, Wafer fab, Wafer Test, module data	User
Shipping Constraints	System

Output	Type
Rules	System

SRD

(Registration Phase, Containment Actions)

Figure 18: Inputs and outputs of SRD application

2.4.4.3   Architecture Summary

SRD belongs to the SAP ABAP program layer, just above the SAP core system layer, which includes the database and ABAP interpreter. Every considerations previously made to the architecture of SAP still apply for SRD.

2.4.4.4   Interface Summary

SRD has the typical SAP transaction interface, as figure 19 shows.

It contains five main areas: definition of the customer to which the exclusion rule will apply, the definition of the sales product, the definition of the finished products affected, definition of Date Codes/Lot numbers and Exclusion or Inclusion settings, approval Management (by the person referenced in the "username field").
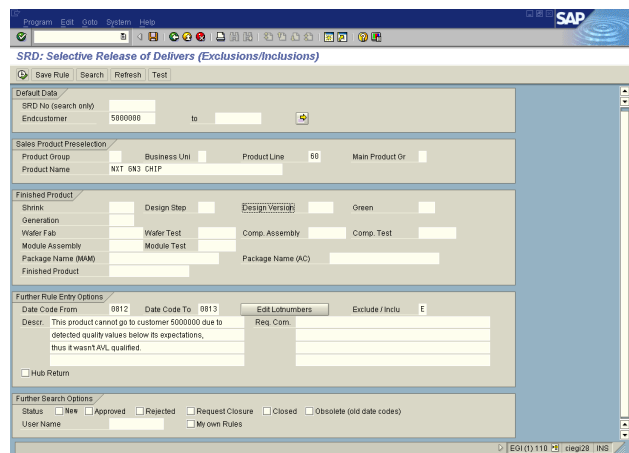
Figure 19: SRD interface example in SAP

2.4.4.5   SWOT analysis

Strengths – SRD is a very simple application since it was integrated in SAP. Being so, it became more focused on core objective than previous SRD integrated in RDC tool

Weaknesses - *"The IT-tool used for blocking doesn't provide proper release features (assessment, traceability, documentation)"* (Qimonda, 2007). It is a SAP development so it may face compatibility problems if SAP version is upgraded in future.

Opportunities - The SRD application could integrate the functionality of SPI (another application inside the RDC tool, described in the next section), since SRD idea is: "This product shall not go to this customer" and SPI idea is "This product only goes to this customer". Theoretically, SRD could include the SPI functionality if it would be possible to block a product for all customers except one (or an exception list).

Threats - Sensitive context (care has to be taken to avoid accidental blockings).

2.4.5   SPI – Special Product Identification

In simplistic terms, SPI is a Web application inside RDC platform (Restriction on Delivery to Customer) used to report routings of a specific finished product to a particular customer, while advising non-shippability of those products to any other customer. The RDC SPI allows only the reporting of cases, as they are created through an external tool.

SPI is a contention measure support application.

2.4.5.1   Functionalities

SPI allows:

- Search and reporting of SPI cases (also to Microsoft Excel).

2.4.5.2   Data Flows

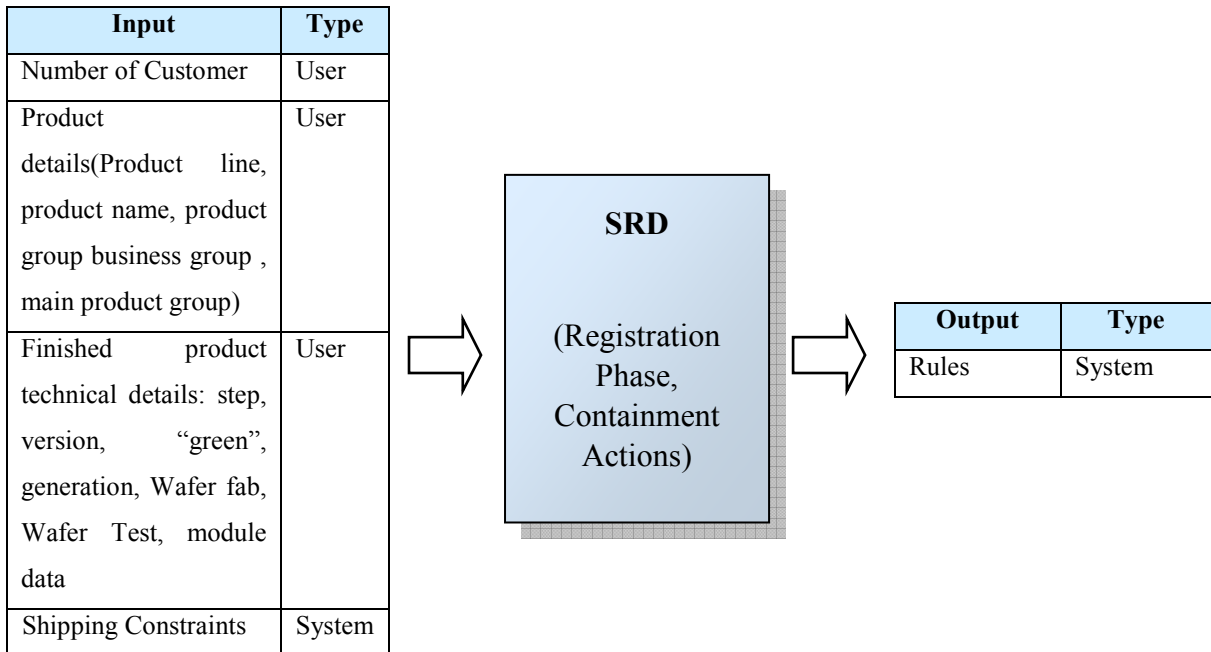Figure 20 shows the inputs and outputs of SPI in the phase of the Customer Returns that it is used.

Input	Type
Customer data: name, customer id, etc	User
Product master data: technical characteristics, technology, etc	User
Dates: valid from/valid to	User

Figure 20: Inputs and outputs of SPI application

2.4.5.3 Architecture Summary

SPI relies in the architecture of RDC platform (which supports also AVL application, described in further sections), and has three main objects: the DB server, the Windows IIS Server and the Windows client, as shown in figure 21.
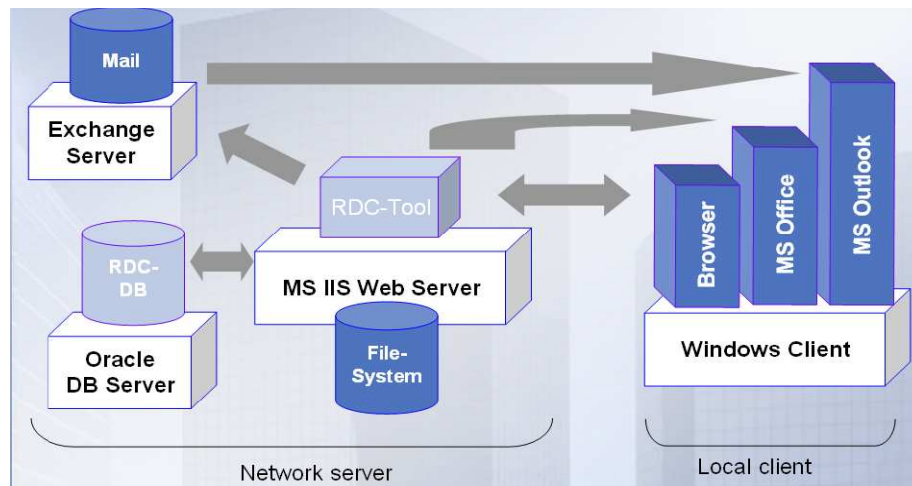
Figure 21: RDC architecture, the basis of SPI application

2.4.5.4 Interface Summary

After completing the login process, user will be presented with the filter screen shown in figure 22:
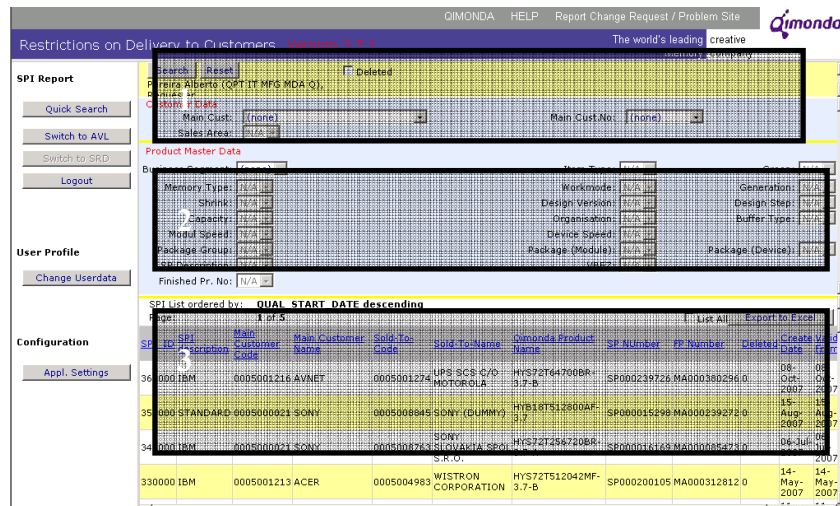
Figure 22: SPI application interface example in SAP

It contains three main areas:

1. Definition of the customer the current SPI case is applied to);

2. Definition the product master data (similar to the SRD product definition) ;

3. Report List of the SPI cases.

This screen allows the search of the SPI cases by any of their fields, and presents the results in the list. There is also a button to export data to Microsoft Excel.

2.4.5.5   SWOT analysis

Strengths - It is a simple application and provides an assisted search (it's not necessary to input all the search fields: as some fields are being set, the program automatically reduces the scope of the search).

Weaknesses - RDC tool is being dismantled and replaced with SAP solutions.

Opportunities - Integrate SPI functionality in transaction ZSRD in SAP as their functionalities are interrelated.

Threats - It is a simple application and provides an assisted search (it's not necessary to input all the search fields: as some fields are being set, the program automatically reduces the scope of the search).

2.4.6   AVL – Approved Vendor list

AVL is web application inside RDC (Restriction on Delivery to Customer) used to confirm qualification status of Qimonda products by its customers. This tool can be described as a "feedback" gathering tool, and may be used to measure customer satisfaction: a product described as "non-qualified" by the customer is not positive: when that happens, Qimonda takes all the needed measures to ensure that the product is qualified again (for example, by creating an SRD case and executing the adequate actions). So although at first glance AVL appears to be outside the Customer Returns Process, it is not: if a product is not qualified, many times it may originate a customer return, as customer will not want the product because it does not meet its quality requirements. If a product is not qualified, then containment actions may be triggered and actions within the supply chain shall be taken in order to assure qualifying.

Customers can be divided into AVL enabled (the ones which can give their qualification feedback) and the not AVL enabled. The AVL enabled customers receive qualification samples (for example through normal shipping or special clearances) in and a FAE (Field assistant engineer) assesses the compliance with their requirements. A qualified product is a product which is in compliance with the requirements.

The product qualification may have one of the several statuses listed in table 6, set by the customer.

Table 6: AVL product qualification possible statuses

Status	Observations
New	Draft status of an AVL entry, automatically assigned on creation phase
Planned	Plan Status of an AVL entry manually set by users.
Qualification failed	Product was not approved by customer manually set by users.
Qualified	Product accomplishes customer requirements
In qualification	Qualification status of an AVL Entry manually set by users.

2.4.6.1   Functionalities

AVL allows:

- Search and report of AVL qualification statuses (Export to Microsoft Excel possible);
- Manage the "AVL enabled" customers (set the customer which can give a product qualification).

2.4.6.2 Data Flows

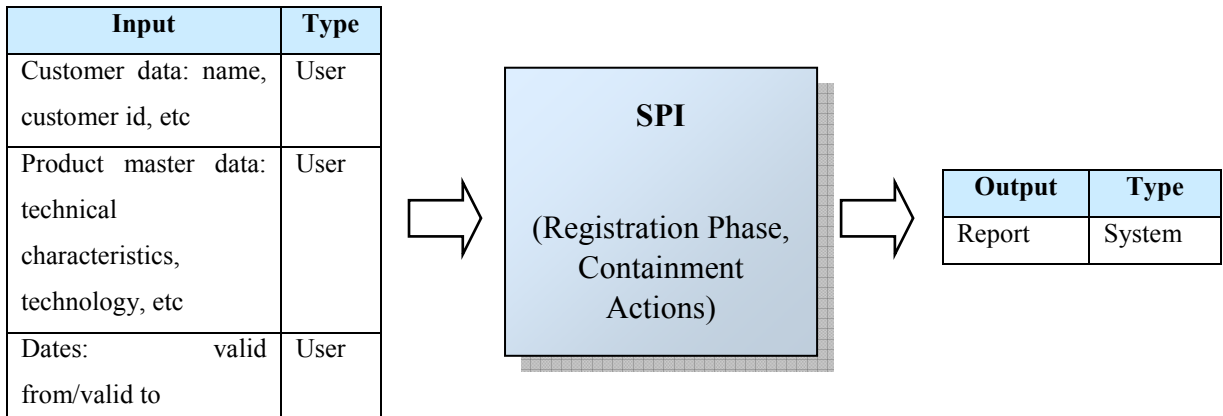Figure 23 shows the inputs and outputs of AVL in the phase of the Customer Returns that it is used.

Input	Type
Customer data:	User
Product master data: technical characteristics, technology, etc	User
Specific Data: PLL, register, design step restriction,	User
Qualification data	User
Attachments	

AVL

(Registration Phase, Containment Actions)

Output	Type
Product Qualification feedback	System
Email alert on qualification status change	System

Figure 23: Inputs and outputs of AVL application

2.4.6.3 Architecture Summary

AVL relies in the architecture of RDC platform (which also supports SPI). It is already described in the previous section.

2.4.6.4 Interface Summary

AVL interface is, in appearance, quite similar to the SPI one (figure 24), as they share a common platform. It contains four main areas:

1. Customer data (definition of the customer the current AVL case is applied to);
2. Definition the product master data (similar to the SRD product definition);
3. Report List of the AVL cases with edition possibility;
4. Main menu (contains options to create a new AVL case, to search for AVLs, to change user profile and Customer ability to qualify products ("AVL customer enabling") and to dump data to SAP.
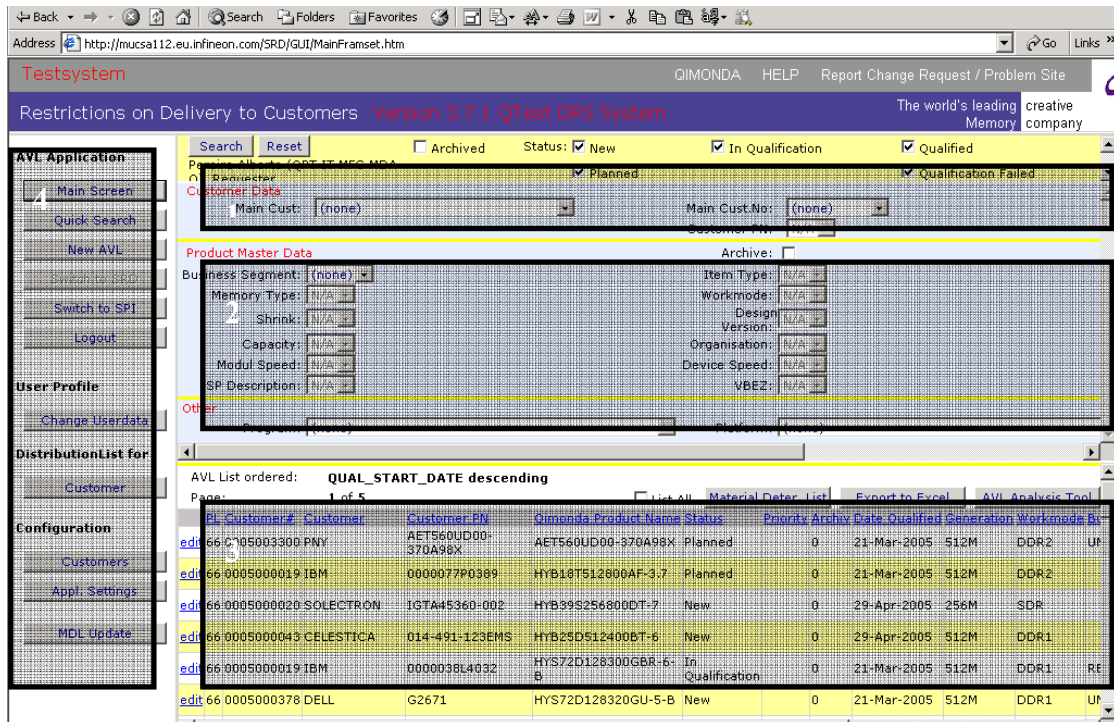
Figure 24: Interface of the AVL application

2.4.6.5   SWOT analysis

Strengths - AVL application has an assisted search (it is not necessary to input all the search fields as some fields update automatically reducing the scope of the search), and is a tailored solution.

Weaknesses - The application could be simplified both for user and support team, as the database update mechanism is complicated and not efficient, compared to a possible SAP integrated solution. RDC platform is expected to be gradually dismantled and its functionalities migrated to other systems (ex. SAP).

Opportunities - This application could be integrated in SAP, as it is a material qualification tool, so it might be included in MM (Material Management) module.

Threats - None.

2.4.7   SC – Special Clearance

SC is a Lotus Notes application used to implement the Special Clearance process that deals with special "non-conforming" shipping requests of products of questionable quality or other with related customer restriction.

Even if a customer return case drove the blocking of a material to a customer, sometimes, due to special reasons the product has to be shipped to customer. This decision is executed after being approved in SC. For example, the SC application can be used in the final phase of the customer return process. For example, although a batch of products may not be in conformity the quality requirements of a customer, they might be shipped for other purposes or other customer. It can also be used for special CRM LAB shipments to customers of products tagged "not usable" but useful for testing purposes. In a more concrete way, a special clearance case may be initiated at any point of the Customer Returns (it can also be initiated from outside the CR process). For example, it may be initiated in the registration phase as a contention measure (a special delivery of an item which is not supposed to be shipped to a customer). A case is then created with info on risk assessment, reasons for special clearance (technical references, e.g. QMR), product identification of material affected, ambition for Special Clearance (e.g. sale to key account). After this, the approval and signoff are done by each party involved, based on own risk analysis and Business Assessment with definition of instruction for special handling or shipping restrictions.

The last step is the acknowledgement by inventory management of all regions and distribution of special clearance info to all relevant parties to be involved and informed. This step ends with the dispatch of special clearance material/products according to instructions and restrictions defined.

2.4.7.1   Functionalities

SC application allows:

- Creation / edition / publication /search of SC cases: can be created from scratch or "create with metadata" (by copy of an existing one);

- Supports an approval workflow with each responsible person makes the signoff, the reason and the date;

- Supports the attachment of files.

2.4.7.2   Data Flows

Figure 25 shows the inputs and outputs of SC in the phase of the Customer Returns that it is used.

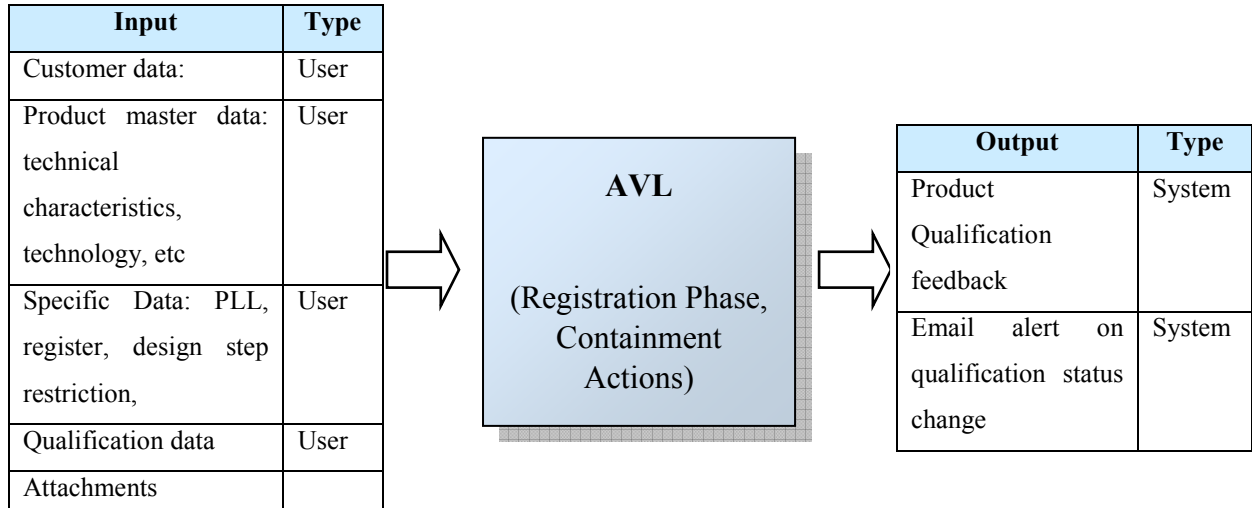| Input	Type
SC type	User
Spider categories	User
Title	User
Nonconformancy / deviation	User
reason/ambition	User
handling/shipping restrictions	User
Attachments	User
product	User
content approvers	User
Applicant	System
Department	System
Location	System
Date	System
Version	System
Signoff	System
Decision	System

SC

(Registration Phase, Containment Actions)

Output	Type
Notification emails to the approvers	System
Decision	User

Figure 25: Inputs and outputs of the SC application

2.4.7.3   Architecture Summary

SC is a Lotus Notes database and its architecture was not disclosed.

2.4.7.4   Interface Summary

SC presents a typical Lotus Notes database interface, with the screen being divided in two areas: the menu (left side) and the report screen (right side), as shown in figure 26.
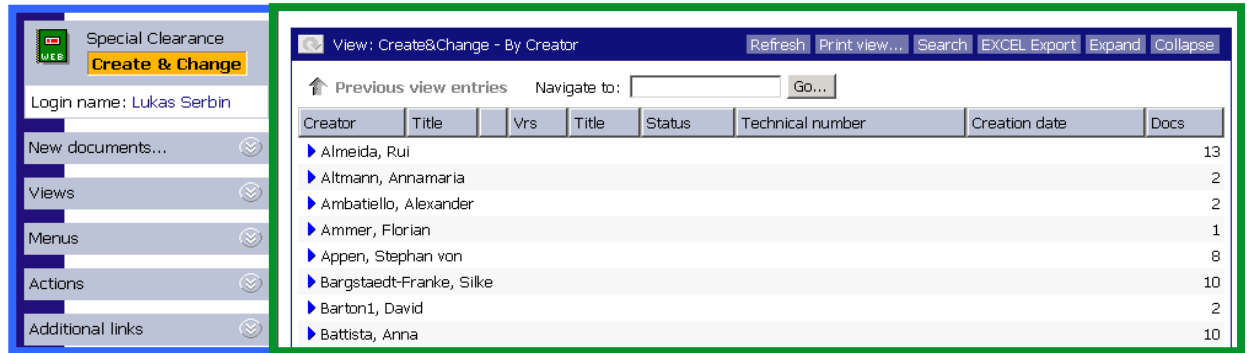
Figure 26: Interface of the SC application

2.4.7.5 SWOT analysis

Strengths - SC has a very good user interface and is a simple application. It is a tailored solution for the Special Clearance containment action process.

Weaknesses - Does not meet directly (only with attachments, but by far it is not the best solution) one of the requirements of the Special Clearance process, the Risk Assessment. It is believed that this risk assessment could be done much better in SAP through SAP tasks. This application is also a stand-alone application, which means it has lack of integration with other systems.

Opportunities - There is a strong conviction that this application may be included in SAP. The business side already requested an evaluation of that hypothesis, so there is already motivation from the users.

Threats - This program is clearly a potential integration target, so there are not many opportunities left for it. It is based in Lotus Notes technology, so connecting it with SAP is not feasible.

2.4.8 QMR – Quarantine Material Request

QMR is a Web application used to implement the Quarantine Material Request process, which ensures that all material of questionable quality is immediately and securely quarantined within production and within the whole supply chain in order to guarantee no further escapes to customers.

After a CR case is initiated, it may be necessary the adoption of immediate measures in order to control defect lots that may be at the supply chain (or even maybe already in

transport to the customer). QMR is used to accomplish that objective: quarantine defect lots throughout all the supply chain. It is a really important application as it supports the most critical and fastest response containment action. QMR regulates how suspect material can be identified, located, put on hold and disposition be stopped with immediate effect and how the decisions on further handling of such material are made and by whom. The quickness of response plays a fundamental role because it is vital to protect Qimonda from being exclude from the approved suppliers by its "key accounts"; loosing important points at Quality Business Rankings, thus losses in business; liability claims, etc…

In a broader scope, QMR application is part of scope of IFX core processes 'Demand to Stock (DtS)' and 'Order to Cash (OtC)'. DtS provides delivery capability by producing high-quality products at minimized costs. OtC is the process fulfilling customer orders and receiving payments for orders delivered. OtC drives the processing of all customer orders and creates the framework for DtS.

When the need of implementing quarantine measures is detected, the QMR is requested, by the applicant. Afterwards the problem is identified and the local Quality is contacted, in order to make the risk assessment to decide to proceed with the QMR case. If so, a QMR case manager is assigned. Affected lots are then identified. The QMR is then started, with all the relevant destinations being informed about what blocking measures they shall implement. The affected material is then blocked throughout the supply chain. If some lots escaped towards distribution centers, then GCT (Global containment team) activities are initiated: a QMR case manager is Re-assigned and another risk assessment is performed. If the products are already at external customers, products may be recalled or a provision of anticipated losses shall be done. If the products are still within Qimonda, then a decision on that to do with the defect material has to be taken: rework, special clearance, scrap or re-release. The case is then closed.

2.4.8.1   Functionalities

QMR application allows:

- Create QMR case (and QMR-child cases, for lot propagation containment effects);
- Search /export / delete or cases (Export to Excel possible);
- Other general functions:
    - DMS document management system (access QMR Excel Sheet or add/access other attachments);
    - Copy QMR case.

2.4.8.2 Data Flows

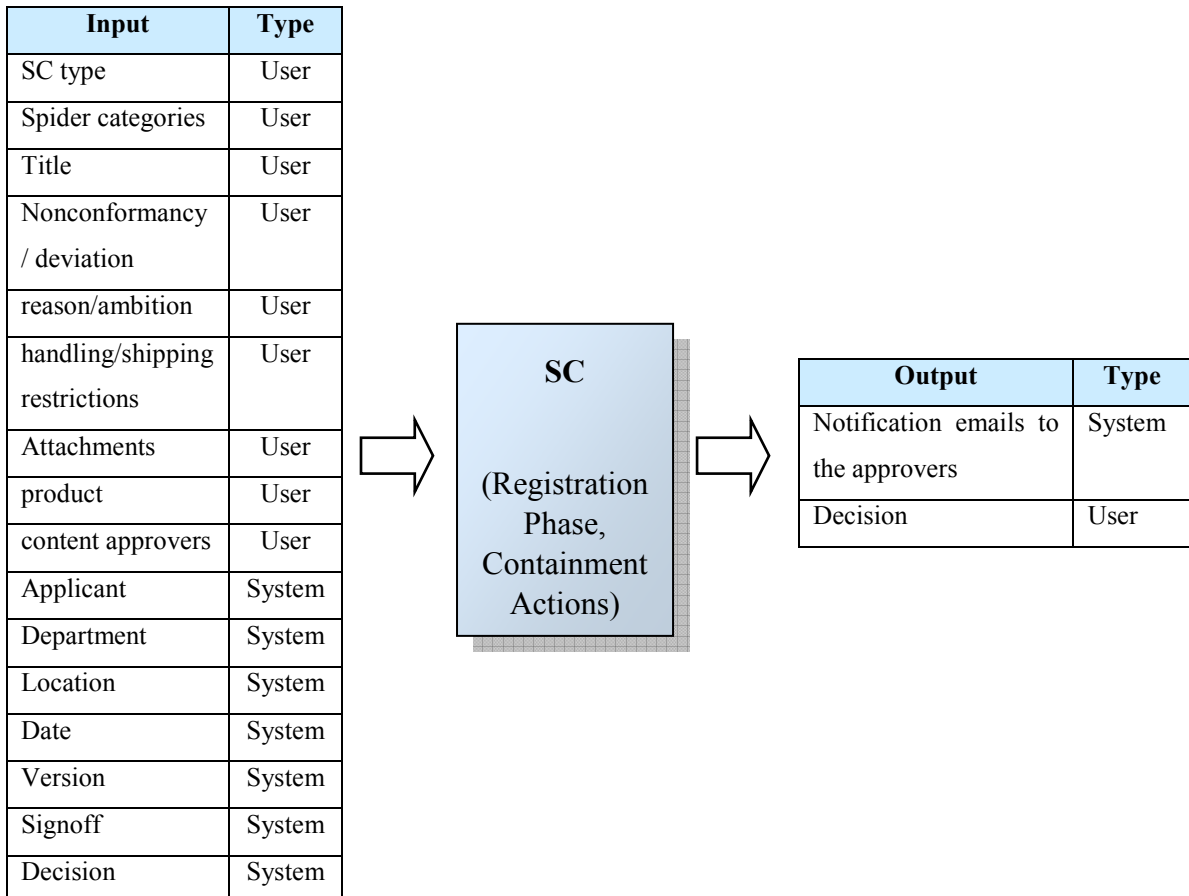Figure 27 shows the inputs and outputs of QMR in the phase of the Customer Returns that it is used.

Input	Type
Product ID	User
GF affected products (only one per QMR)	User
BG according to affected products (only one per QMR)	User
Problem and background info	User
Remarks	User
Quantity	User
Fulfillment	User
Risk assessment:	User/ System
QMR case Manager	User
Logistic data on affected lots in the corresponding QMR Excel Sheet	System
Bau# (Provided by local logistics)	System
Lot# (Provided by QMR creating party)	System
Product name	System
Qty (provided by local logistics)	System

QMR

(Registration Phase, Containment Actions)

Output	Type
QMR case	System
Excel data sheet	User
Feedback from all the parties involved in the process	User
Decision on material: - Rework - Scrap -Re-release (With Restrictions (Possibly using SPI/Special Clearance), Without Restrictions) - Ship by special clearance - Recall	User

Figure 27: Inputs and outputs of the QMR application

2.4.8.3 Architecture Summary

Table 7 shows the main data types and the tables where they are located:

Table 7: QMR data tables

Data type	Tables
Documents	QMR_LIGHT_DOKUMENTS
Categories	QMR_LIGHT_CATEGORIES
Users	QMR_LIGHT_KLUSERS, QMR_LIGHT_AUTHORIZATIONS
Lots	QMR_LIGHT_LOT_PROCESS, QMR_LIGHT_LOT_STOCK, QMR_LIGHT_LOT_TRACEABILITY, QMR_LIGHT_LOT_DC (not in use), QMR_LIGHT_LOT_CUSTOMER
Costs	QMR_LIGHT_COSTS, QMR_LIGHT_BUDGET
Network	QMR_LIGHT_NETWORKELEMENTS

QMR is an ASP web application and it runs from a IIS (Internet Information Services) server.

2.4.8.4   Interface Summary

QMR is a typical ASP web application. Figure 28 shows the report screen that presents the QMR cases in which user plays an active role.

Figure 28: Interface of the QMR application

Above the report list there are four buttons that give access to the common functionalities: export data, create a new QMR case and search.

2.4.8.5   SWOT analysis

Strengths - It is a tailored solution.

Weaknesses - Is not easy and straightforward to use (due the complexity of the QMR process and the use of an "excel sheet" for lot traceability, as it lacks integration with automatic lot-traceability procedures (but version 2.0 will have some). QMR lacks integration

between customers, lots and products. This would be achievable if it was somehow connected to SAP and FAB (a shop floor software), but Tat time should remain below 24 hours.

Opportunities - This investigation work can launch the basis for the integration the QMR application in SAP, so there is a clear integration opportunity. It is believed that the distribution of tasks, emails sent, etc could be much more powerful in SAP, if correct workflows are programmed.

In dream vision", the QMR process could be implemented in a much more sophisticated way in order to reach the "after DC" routed products: SMS alerts before products reach customer, etc. It could benefit from SAP integration, speeding up the production in shop-floor activities in case of implementing containment actions (produce more of the same product for delivery to an affected key customer).

If we could have a visual application, to track the lots within the production chain (instead of just textual) it would be much more simple and intuitive to track the lots. But of course this would only make sense if the information coming from the different needed sources (customer, lots, deliveries, production chain) would be integrated.

FAB integration would be needed, as well as SAP integration, but the complexity and timings of data flows had to be greatly improved (which would require re-engineering in those applications, which is not feasible as FAB is a critical application). A middleware integration platform would be needed, and then QMR could be built on it.

Threats - There is a QMR 2.0 version waiting for definitive implementation. The complexity of the "dream vision" implementation is very high which makes it not feasible.

2.4.9 Catbrow

Catbrow is a software tool used for classification of memory product fails during qualification, monitoring and Customer Returns.

Catbrow has three main functions:

- Data viewing: Catbrow is used to visualize data related to the failed modules or components;

- Pareto Maintenance: Catbrow is used to maintain the approved pareto category values;

- Categorization: Catbrow is used to select and categorize failing hardware. The categorization results are saved to a common table and exported to SAP.

After executing tests relative to the customer returns, VMI (Visual and Mechanical Inspection) operators or backend assistant fill the respective categorization fields in Catbrow. So the SAP-Catbrow interaction starts after case is registered in SAP QM, as that information

will be available in Catbrow to help categorization. Together with the test results will be the basis upon categorization will be made. When categorization is finished, the results will be exported to SAP.

2.4.9.1 Functionalities

Catbrow application allows:

- Viewing standard test data and detailed test data from several Backend Sites, concerning Application, Advantest or other tests;
- Categorization of fails: choosing the hardware and choosing fail categories;
- Changing categories (permission protected).

2.4.9.2 Data Flows

Figure 29 shows the inputs and outputs of QMR in the phase of the Customer Returns that it is used.

Input	Type
Categorization	User
Category values	User
SAP Complaint info	System
Lot information	System
Item info	System
Test data	System

Catbrow

(Categorization Phase)

Output	Type
Failure Categorization (to SAP)	User/ System
Failure categorization XML files (to EBS)	System* (not implemented yet)
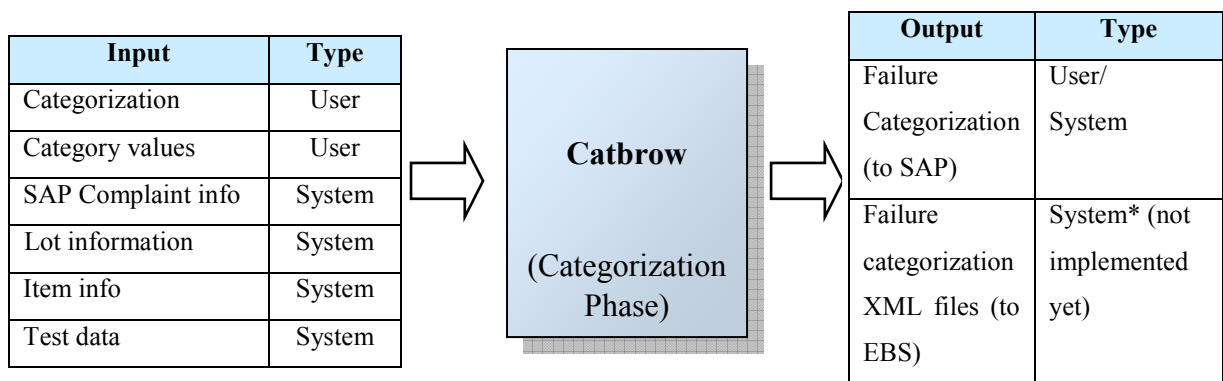
Figure 29: Inputs and outputs of the Catbrow application

2.4.9.3 Architecture Summary

Catbrow database is made of five main tables:

- CR (related to the Customer Returns);
- APT Backend;

- APT LAB;

- Advantest BE;

- Categorization.

These tables store all the information that comes from the backend LPC[1] application (test data). A new feature will also enter in productive environment next summer: Catbrow categorization data export to EBS.

Catbrow has also a data interface with SAP QM.

2.4.9.4   Interface Summary

Catbrow is a windows application. It has four user modes: Customer Returns, APT backend, APT Lab and Advantest Backend. It allows choosing the database location from where we want to get the test data (Backend sites): Dresden, Richmond, Porto, Malacca, Munich, RTP-Carey, Burlington (Sunrise) and Suzhou.

The test data is shown in a table whose columns show several values related with the tests performed for each item (figure 30). This screen also allows the fails to be categorized.

Figure 30: Example of the Catbrow application interface

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[1] LPC is a software used in DRAM production and testing

2.4.9.5   SWOT analysis

Strengths - Catbrow has a correct level of permissions (not everybody can change the category values) and meets all the business needs. It is integrated with previous CR phases (by receiving data from LPC (Analysis) and exporting data to SAP (to be used in the next phases) which makes it an excellent tool for the management of test data, used by several business groups.

Weaknesses - No notable weaknesses.

Opportunities - For the actual business process, no need to be developed

Threats - It is used by several user groups and it makes no sense splitting it.

2.4.10 CRI and ATT applications

There were also two more applications which support the Customer Returns Process: the ATT (Analysis Tracking Tool) and the CRI (Customer Returns Improvement), which are related to the Analysis Phase and the Quality Improvement initiatives.

Analysis Tracking tool is a web application used for tracking of complaint cases. It allows the effective management of the analysis tasks along the verification process: task distribution and result reporting, inside CRM or between test sites. ATT allows an efficient management of an analysis in a centralized way. It also allows grouping / splitting common cases in order to achieve a more efficient analysis.

Customer Returns Improvement is Lotus Notes database which stores knowledge about the Customer Returns. For each problem already found and solved, CRI database has an entry for it, which contains data about the corrective actions, measures e.g. 8d reports. Each CRI entry represents the corrective action or activity done to eliminate a single root cause. CRI is a knowledge base which stores and organizes the knowledge learned in the investigation of the root causes and the corrective and preventive measures. This knowledge, in the form of pictures, documents, 8d reports will be useful to the final phase of the Customer Returns: the closure and reporting.

These two applications were already studied and integrated with success in SAP QM in the previous internship developed by the student, so their study was out of the scope of this project.

2.5   Process and IT applications - Summary

The processes and IT applications were described individually, by explaining the use, data flows and architecture summary of each application. Nevertheless, each process and each application does not act separately: they have multiple dependencies and intercommunications. Figure 31 shows the IT applications used in each of the subprocesses of the Customer Returns Process. As it is observable, SAP QM is the main application behind the Customer Returns process, as it supports every subprocess. This is not a surprise, as SAP is nowadays the main information system within Qimonda, being the backbone of the Quality Management.
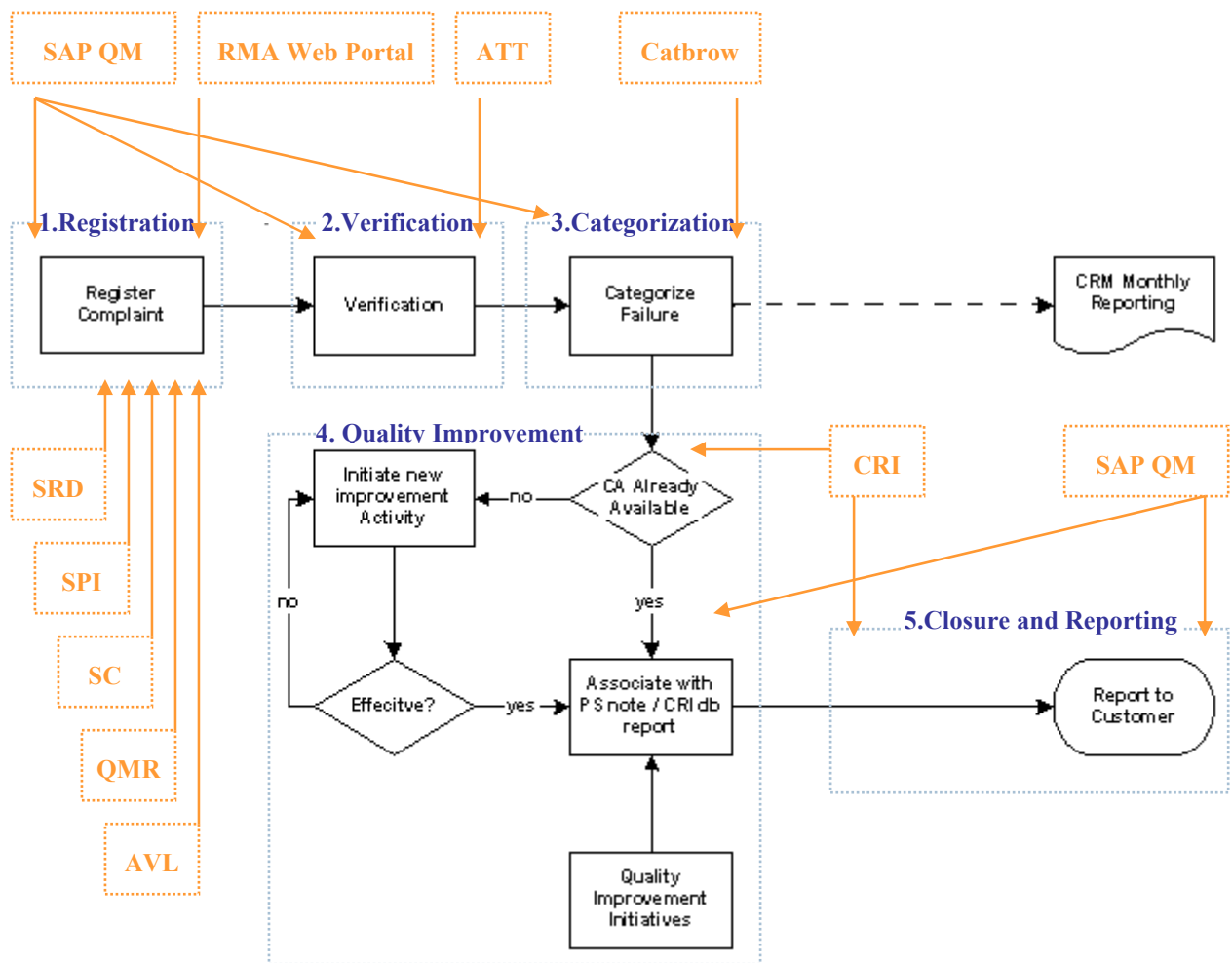
Figure 31: Subprocesses and Applications within the Customer Returns Processes

SAP QM and RMA Web Portal allow the return registration and approval, although RMA is only used in QNA QM so it is considered a regional solution. The registration data together with the returned material are analyzed in the Analysis phase, through ATT, SAP QM and other production and test support tools (called "fabtools") that are out of the scope of this project.

The results of the analysis are used in the categorization phase, integrated in Catbrow database, categorized and the categorization is exported to SAP QM.

With that categorization, the Quality Improvement phase starts. The solutions for those categorized problems will be searched in the CRI database. If found, the knowledge associated will be used to build the 8d report. If not, a new research for corrective and preventive measures will start. SAP QM also plays here a fundamental role.

With the 8d report built, the Closure and Reporting phase begins. At this phase, the reports are corrected/customized to specific customers.

The containment actions support Tools are mostly connected to the registration phase, as this is the phase where the containment actions are more likely to implemented (although they can be implemented at any phase, whenever considered necessary)

3   Diagnosis and Solutions

After the analysis of the state of the art of the processes and IT applications, the next step is to search for potential improvement points and investigate the solutions. But before, there is the need to look into the guidelines which would direct the search for new solutions, as the new solutions have to be in agreement with several factors which constitute the background environment of the enterprise. The design and optimization of operations and applications has also some concepts behind which need to be studied.

Completed the study work and having made a study of the foundations which would lead any further improvement evaluation, the next step is to make a complete diagnosis of the problems found, develop and investigate potential improvements and evaluate them from several perspectives.

3.1   General Improvement Guidelines

The organizational background and the application of Lean Manufacturing concepts had a considerable impact in the diagnosis and development of the new solutions

3.1.1   Organizational Background

It is a fact that at Qimonda, SAP is becoming the main information system, each time integrating more functionality. SAP has grown in influence and it is inevitable to consider it as an option for any further solution. This holds true also for QM area where most of the development projects plan some integration/connection in SAP.

Another fact is that the Customer Returns processes have too much software applications and too much fragmentation. It has more software applications than subprocesses, which may be an indicator that the process or application landscape is not lean. Therefore the concept of "Lean Manufacturing" (Kotelnikov, 10.03.2008) can be a good foundation to start the investigation of optimization solution, by opposition to a much less efficient "ad-hoc" practice.

Being so, one key concept is "system integration". If it was possible to reduce the application number through their integration in SAP, this would bring benefits: reduced application number and improvement of the information flow (with all its consequent benefits).

At the start of the project, there was already some conscience by some business groups which perform certain operations of the Customer Returns that some improvements were needed. This was the case with the SC application, where its user group demanded an investigation for improvement and with Catbrow application. Nevertheless, there were other

user groups which did not showed will to change and to adopt new procedures (change resistance), although this attitude changed as soon as they were involved in the discussion of the new solutions.

To proceed with this project meant it would also be needed to comply with its specification and motivations like the following ones (Felino, 2008):

- *"Integrate existing found IT applications in existing platforms"*;

- *"take in consideration the actual Qimonda Guidelines and IT PA AS QS target applications"*.

And also with Qimonda's CEO recent declarations: *"We have to ask as a team what we can do to save resources"*, which in practice means: *"we have to do more with less money"*. The recent semiconductor industry downward spiral poses many challenges to the companies, and the same happens to Qimonda. So as the capital expenditure the costs, all the internal areas will need get leaner processes, increase efficiency and reduce waste.

3.1.2 Value Stream Mapping and Lean Manufacturing

According an author (McBride, 2003) there are 7 kinds of waste in processes (and recently he considered underutilization of resources as the eighth one). Some of them are present in the Customer Returns process:

- *Overproduction* – Not applicable, as the Customer Returns Process is a "Pull Process": the process is triggered by the final customer (whenever it returns goods);

- Waiting – Whenever goods are not moving or being processed, the waste related to waiting occurs. Much of an operation lead time is tied up with the waiting for the next operation. The solution would be to link the operations so that one feeds data directly and automatically into the next;

- Transporting – Transporting a product between processes is a cost incursion which adds no value to the product. The solution would be to reduce transport to the minimum (data, material, etc);

- Inappropriate Processing – Having expensive applications for performing simple operations which could be done with simpler applications. It is not really the problem at the CR process as its applications are relatively simple;

- Unnecessary Inventory – WIP (Work in Progress) is a direct result of overproduction and waiting. Not applicable as CR is a "pull" process;

- Unnecessary/Excess Motion – Not a problem in the CR process;

- Defects – In this case they can be measured by the number of recurrence of fails which were supposed to be solved. The number of recurrence returns is not considerable at Qimonda;

- Underutilization of resources – In CR process some concurrent applications are used for the same purpose (ex: SAP QM and RMA application at the registration phase) and it decreases individual application workload.

As it is evident, not all kinds of waste are present in the CR process, so not all the lean concepts apply to it. Nevertheless, it would be well worth to try to eliminate waste, through the reorganization of IT applications and processes, with the goal of creating value while consuming as less resources as possible. This implied to make assessments of the advantages and disadvantages through several perspectives.

3.1.3 Process solution guidelines

The first step should be the reorganization of the IT applications, as the processes are quite optimized. With that reorganization, some small process changes would occur.

3.1.4 IT tool solution guidelines

Having analyzed the software applications and discussed with the relevant collaborators inside Qimonda, the main conclusion was that the integration of the applications in SAP QM was worth to be studied, not discarding any other valuable option. This was because SAP QM already supports SRD application, and there were business requests to investigate the integration of SC and Catbrow in SAP QM. Being so, the following guidelines were specified:

- Relatively to the RMA application, after having documented the registration process in detail, the main objective was to design and evaluate a global SAP QM solution and shutdown the RMA application;

- Concerning to AVL, SRD and SPI: AVL could be integrated in the same SAP transaction as SRD. AVL could also be integrated in SAP. This would provide the means to shutdown AVL and SPI "external applications" and integrating the containment actions applications;

- In what concerns to SC application, there was already a business request to investigate its integration in SAP, so a response to that request had to be given;

- Regarding to QMR, the guideline was to make a very brief assessment of its integration as part of the containment measures applications;

- Catbrow: evaluate the migration possibility to SAP;

- ATT and CRI: integration study in SAP was already concluded by the student in the previous internship, so they are out of the scope of this project.

Implementation cost estimations shall only consider the Accenture work cost.

3.2   Phase I – Registration: Diagnosis and Possible solutions

Diagnosis

Qimonda regional QM sites execute the whole phase in SAP. QNA QM, however, has a variation of this process by using SAP together with RMA web application. The return orders are created in SAP SD and put on hold waiting for approval. The list of pending return orders is sent to the responsible person who creates the return management authorization cases in the RMA application. RMA application imports invoice data from SAP and automatically decides (based on the configured credit threshold values) the right approval parties and sends them a notifying email to input their decision on the specific case. The customer demands are registered in RMA web application. But QNA also registers the corresponding complaints in SAP QM, which doubles the user effort: user has to input again the customer requirements and all the relevant details.

In other regional QM sites, only SAP is used. The complaints/returns are registered in SAP QM and the customer requirements and the sales orders are then set. The complaint manager is defined and if all the data is correct a confirmation email shall be sent to the customer. The approval process is initiated by the complaint manager, who creates a general task and sends it to the responsible people for the approval. If the credit is approved then the complaint manager executes the "initiate return management" task to request the creation of the return order.

As it can be seen, QNA uses SAP+RMA while the rest of the QM sites are using only SAP. This can be partially explained by the fact that Qimonda has some special requirements in the financial accounting area, due to the SOX measures. US companies with a market capitalization of over $75 million (U.S.), have to implement SOX compliant credit policies and procedures for the credit function. Additionally, the credit department may have to provide and or obtain certification for the process and work performed in their domain. This implies increased roles of responsibility and risk for the credit professional. This is the main reason of the definition of the threshold values in RMA to automatically select the needed approval parties.

But the key impact of SOX revolves around three sections of the act and they are Section 302, 404 and 409 (Wikipedia, 23.03.2008):

- Section302: Officers of the company must make representations related to the disclosure of controls, procedures, internal controls and assurance from fraud;

- Section404: The company must provide an annual assessment as to the effectiveness of internal controls in financial reporting and obtain an attestation from external auditors that the controls are effective;

- Section409: The company must disclose to the public on a "rapid and current basis" material changes to the firm's financial condition.

After the investigation work on the solutions, a conclusion could be taken: the features that RMA provides can be integrated and reworked in SAP in order to even increase SOX requirements compliance, as SAP provides powerful reporting capabilities.

So there is a clear improvement opportunity here: to streamline process and IT landscape in QNA, by finding solutions for quick and efficient approval and reporting on the approvals, in order to shut down RMA application and to standardize processes globally.

<u>Possible Solutions and Evaluation</u>

RMA core functionality is the approval workflow of the return management customer requirements. To include that functionality in SAP, we have two choices:

- Include the functionality inside the SD area, possibly by adding some control and workflow for approval (and so the order would be automatically set "on hold" till the approval and executed automatically after that). This workflow would have to involve automatic email send to the approval parties. The determination of the right parties would have to be automated and hardcoded or manual and flexible;

- Include the functionality inside the QM area. This means adding some task to the N1 and N2 notifications to support the approval. This could be done by copy of a "containment action implementation" modified for this concrete purpose. This also included the email notifications to the approval parties and access to SAP web. This solution has a smaller degree of automation and requires more manual input.

The first solution presented has two major downsides in comparison with the second solution: it requires more development resources (budget, programming of workflows and automated mechanisms) and it does not support standard and consistent reports on the approval status, which is fundamental. However that solution needs less user effort and assures a smooth transaction for RMA users. From the business point of view it does not meet the requirements, as it does not support adequate reporting. (Non-standard developments are not supported by SAP standard reporting)

The second solution is more feasible since it needs fewer resources to be implemented (although the cost will increase if a greater automation degree is demanded). As the "containment action implementation" task is a very good basis and will only require a small modification, this solution can be implemented faster. The approval parties must be set manually (the emails to send), so it would require decision from the user on the right signoff parties. This solution would need a closer accompaniment of the user migration to the new

paradigm of approval, as user resistance may be higher as it implies more user input (although there is less time spent as only one application is used).

3.2.1 Solution 1 – Include RMA web application functionality in SAP QM

SAP QM is the starting point of the Customer Returns Process, as it is here where the complaints (internal and external) (or in the cases that an important customer just returns the items because he doesn't want them anymore and wants to have them replaced) are registered, through the use of N0, N1 and N2 notifications. By including the approval loop inside the notifications, we can enclose the whole process within SAP. Another very important part is the reporting of the approvals. This can be done through the use of the Worklist transactions.

By using QM01 the notification structure is created as stated in the complaint management manual.

After creating the complaint structure, the customer data, the complaint key and the returned quantities are input. The start and end dates are inserted and the complaint manager is chosen. The complaint manager will have the responsibility for the execution of the approval process by executing the task "Request Return Material Authorization", releasing it to send the corresponding emails to the correct approval parties (this is not an automated decision like in RMA web application, so user has to know the right approvers and threshold values). The complaint manager sets the short task text to "RMA approval pending". After the approvers give their feedback the complaint manager sets the short task text to "RMA Approved" or "RMA Rejected", and sets the task status to "Approved" or "Rejected". This is a very important step as it will allow the reporting and filtering of cases.

If the credit was approved, then the complaint manager executes the "Initiate return management" task, in order to give the instruction to the responsible person or department to create/unblock the return orders or take other adequate measures. Customer is informed of the status of the case and other relevant details about it (case/return order number, etc).

The development of this solution is based in the customization of current SAP N1 and N2 notifications. More concretely, the objective is to add a new task to the action box which will send approval emails and provide the correct task statuses (pending/approved/rejected). The technical development of this solution can be found in the appendix 7.

3.2.1.1 Implementation Plan

Prior to the effective implementation of this solution and shutdown of the RMA application, the first step shall be to motivate the people involved. As most of the changes this solution brings will be reflected in QNA, there is the need to involve QNA QM collaborators in order to decrease resistance to change. A meeting with QNA QM head person would be necessary in order to create a commitment to the success of this implementation.

An approach to technical implementation would comprise the following phases:

1. The solution is Analyzed by the QPT IT PA, together with the relevant business parties to assess if the improvements are worth and desirable and time pertinent;

2. Create the SAP change request and attach the corresponding specification file;

3. Accenture evaluates and estimates and implementation resources needed (Unit: Man days);

4. QPT IT PA AS makes an assessment of that evaluation and decides to implement, not implement or postpone it if resources (budget) are not available yet;

5. When implementation is decided, QPT IT PA AS has to schedule the project accordingly to the budget available and project priorities;

6. SAP Accenture implements and tests it;

7. Release to productive system.

An approach to the user implementation plan would comprise five phases:

- Present the improvement program;

- Define with QNA QM head Christine Wyche a group of test users (suggestion: Donnie Sales, Janet Dixon and Deji Fajobi);

- Define the documents to produce for training (initial and further learning): Quick start guide, user manual;

- Training;

- Obtain feedback and include it in a continuous improvement model.

3.2.1.2   Resource Planning

Budget and Return

Assuming an average man day price of 550€ (according to Qimonda internal numbers), the development and implementation cost of this solution (2-3 man days) would be of 1650€.

The direct financial benefits of this solution would be a direct consequence of the RMA web tool shutdown. Assuming an average cost of the hiring of a web server of 25/50/75/100€/month (assuming this application is in a shared server) and assuming a slight increase in the SAP server load is irrelevant in financial terms, a simple investment project analysis was made in order to have a quick forecast of the time this solution will need to bring financial benefits. This analysis excludes workforce considerations, server upgrades, "bug" fixing budget, downtimes and reliability, as those studies have to rely on concrete data, which

is not available at the moment. Still, those factors would certainly benefit this solution vs the actual solution being used in QNA.

Figure 32 illustrates this simple investment project analysis (considering a yearly average inflation rate of 2% and a temporal horizon of 4 years)
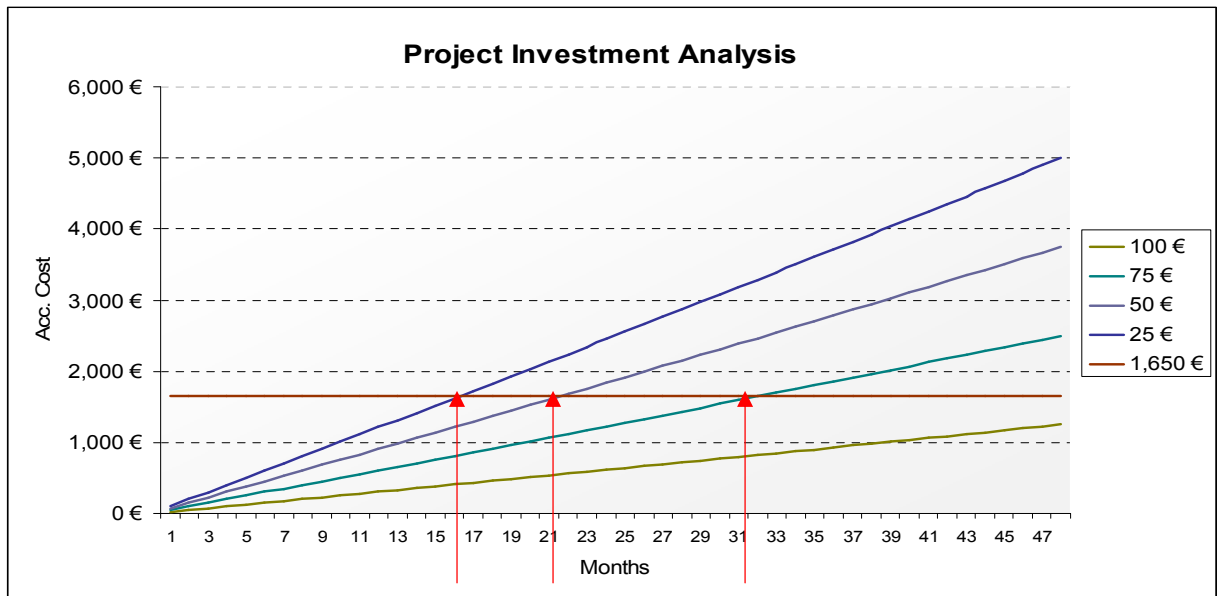
Figure 32: Project investment analysis

The following conclusions can be extracted:

- Breakeven will not happen in the first year of implementation, if the server rental cost is above 25€ month;

- In the best case the breakeven will happen at the 16th month;

- In the worst case the breakeven will not happen in a 4-year forecast.

Still, there are many other factors which will speed-up this time: increased productivity, faster response time, global RMA reporting, data availability and consistency. So in terms of organizational financial benefits, there is the conviction that this solution will bring tangible benefits and it is well worth to implement it.

Time

Table 8 shows an estimate of the technical implementation time range:

Table 8: Implementation schedule

Week 1					Week 2					Week 3					Week 4					Week 5					Week 6					Week 7				
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

1. **Evaluation** [Range: 5-10 days]
2. **Request** [Range: 1-2 days]
3. **Evaluation** [Range: 1-30 days]
4. **Approval** [Range: 1-5 days]
5. **Project Scheduling** [Range: 4-9 days]
6. **Implementation** [Range: 2-3 days]
7. **Release to productive environment** [Range: 1 day *]

* Releases are usually scheduled to the third Thursday of each month

The time estimates were obtained considering the request falls in a "low priority" category ("Designing and building new functionality and changing the system", according to the Qimonda rules). So, in the best case, the technical implementation will take 20 days. In the worst case, it will take about 2 months, considering that the release happens immediately.

Those measures are just estimates provided by QPT IT PA collaborator.

Table 9 shows an estimate of the end-user implementation time range.

Table 9: End user implementation schedule

Week 1					Week 2					Week 3					Week 4					Week 5					Week 6					Week 7				
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

1. **Presentation** [Range: 1-5 days]
2. **Define group of test users** [Range: 4-10 days]
3. **Elaborate documentation** [Range: 10 days]
4. **Training** [Range: 10-15 days]
5. **Feedback gathering and Improvement** [Range: 15 days]

This table represents a hypothetical end-user implementation schedule based on previous similar experiences. So at the worse case it would take about 35 days to reach an effective implementation, and in the best case it would take about 25 days. This may seem too much considering the small amount of changes, but the tests users will test the new system just when they have some free time.

<u>People</u>

Table 10 lists the people needed to implement this improvement.

Table 10: People needed to implement the improvement

People	Function	Responsibility
Implementation Team	Implement the solution	Accenture
Test Team	Test the solution; bug report; improvement suggestion	QNA QM
QPT IT PA AS	Coordinate and manage all the improvement process	QPT IT PA AS

3.2.1.3   Benefit/Risk Assessment

Including the approval loop efficiently inside the notification structure (as the notification and credit requirements have a 1-to-1 relationship) is advantageous, as a similar solution is already being used at other QM regional sites.

Other advantage is the fact that QM has excellent reporting capabilities through its Worklist transactions QM10/12/14, which if correctly set up could provide all the needed reporting to QNA. If even more powerful reporting is needed, it is possible to use the Business Objects application, which can execute virtually any query on the SAP QM data. But the list of advantages of this solution does not stop here:

- Allows the process to be simplified and unified worldwide while respecting regional specific requirements and SOX credit measures compliance;
- As RMA isn't needed anymore and only SAP is used, the availability of the solution will be higher (so the reliability will also be higher) and there is less waste in the communication.

A forecast of the potential benefits and risks of the implementation of this new solution is not always a straightforward process, as its measure is as good as the assumptions it is based on. Nevertheless is worth to make its assessment. Table 11 shows all the considered factors:

Table 11: Benefit/risk assessment

Factor	Assessment	Benefit / Risk
Human Work needed	User will be using only SAP (one application, less application changes) though it has to make a personal decision on the signoff parties.	Benefit
Information available in making business decisions	Increase of information available in making business decisions, as all the information will be in the same platform. Reporting functionalities are increased in a significant way due to the use of Worklist transactions.	Benefit
Organizational Response Time	The process gets simplified in QNA.	Benefit
Quality of results	The quality of results may be measured by their consistency, availability, reliability. As only one application is used by this solution, the consistency of the results is guaranteed as there is only one common database.	Benefit
Correctness of the Results	The new solution has a lower degree of automation (the selection of the approvers and the interpretation of their feedback is totally made by the complaint manager), and as user is more susceptible to error.	Risk
Efficiency	The new solution is more efficient: brings a simplified and uniform process to the return management authorizations process. RMA application will be shutdown, so there is less an application to support, less waste, less data communication, data conversion, less one database.	Benefit
Waste Reduction	Reduced waiting as the process is simplified; reduced data transport as there is no need to import invoice data from SAP to RMA; reduced underutilization of IT infrastructures as RMA will be shutdown.	Benefit
Cost Cutting	Known cost cuts: support, maintenance and operation of RMA.	Benefit
Business compliance	The process is unified, compliant with Qimonda QM guidelines and with regional specificities (ex. SOX).	Benefit
Security	Although SAP is a secure environment, any user with QM permissions can set the decisions prior by the complaint manager.	Risk
Budget Investment	Estimated Implementation time by Accenture: 2-3 man days.	Not Applicable
Break Even time	As there are no financial details involved there isn't the possibility of making break even forecasts, which increases risk	Risk
Conflicts	Conflicts are less likely to occur by using only SAP	Benefit
Feasibility	The implementation is quite feasible and no difficulties are expected in the technical aspects, although change involves always a risk.	Risk
Operation / Change Costs	If business requirements change, SAP can be customized to accommodate new business demands. Operation costs decrease, as RMA costs are cut. Integration costs are negligible the QPT IT PA AS yearly budget can be used with no extra cost.	Benefit

3.2.1.4 Motivation

IT Side

The implementation of this solution as a part of a future QM roadmap makes sense, as it will be a step forward in the simplification and unification of the global Customer Returns Processes. The process will become trimmer and more efficient, while saving costs in almost every aspect.

The IT department will have to support fewer applications and therefore less complexity as the process would become unified and the support could be done at just one location. The RMA support would not be needed anymore, so QPT IT PA could support all the process. (Competence transfer to QPT, which is always important!)

Business

As this is a pro-active approach towards the improvement of the quality processes, business has to be told that this improvement is significant and will bring the benefits stated in the previous table, but emphasizing the simplification of the IT landscape, processes, improvement in end-user experience and time savings, reduction of waiting, etc.

3.2.2 Solution 2 – Include RMA web application functionality in SAP QM (Enhanced Solution)

The previously described solution was presented to the business client (Qimonda North America QM) in order to be evaluated and to obtain useful feedback which could make clear the points on which the solution should improve. The following areas were identified as the ones needing rework:

- Automation: the initial solution is not as automated as the solution currently in use. This makes the process not as straightforward as expected. This downside is very significant, as it increases user effort with respect to the currently used solution, which would lead to an increased change resistance. Other consequence already discussed in the previous section is that less automation increases user decisions and so it may increase error probability;

- Learning curve: the client forecasts that the initial solution may have a steep learning curve. So increased efforts should be made to assure it does not happen. This may also be related to the "SAP fear". This fear can be eased by demystifying SAP itself and by presenting a new solution like an "almost non-SAP" solution.

These two points were the guidelines for the design of an enhanced solution. The enhanced solution was designed having as a basis the first one, as it was verified that its base concepts and functional foundations were correct and adequate to the problem. The functional requirements were accomplished, but there were performance and user acceptance issues, mainly due to poor automation and increase of user-assessed actions.

Figure 33 shows an UML Sequence diagrams, with the evaluation of the strong and weak points of the current RMA and SAP QM solution in use at QNA and the first solutions. All weak points identified will be object of study in this enhanced solution.
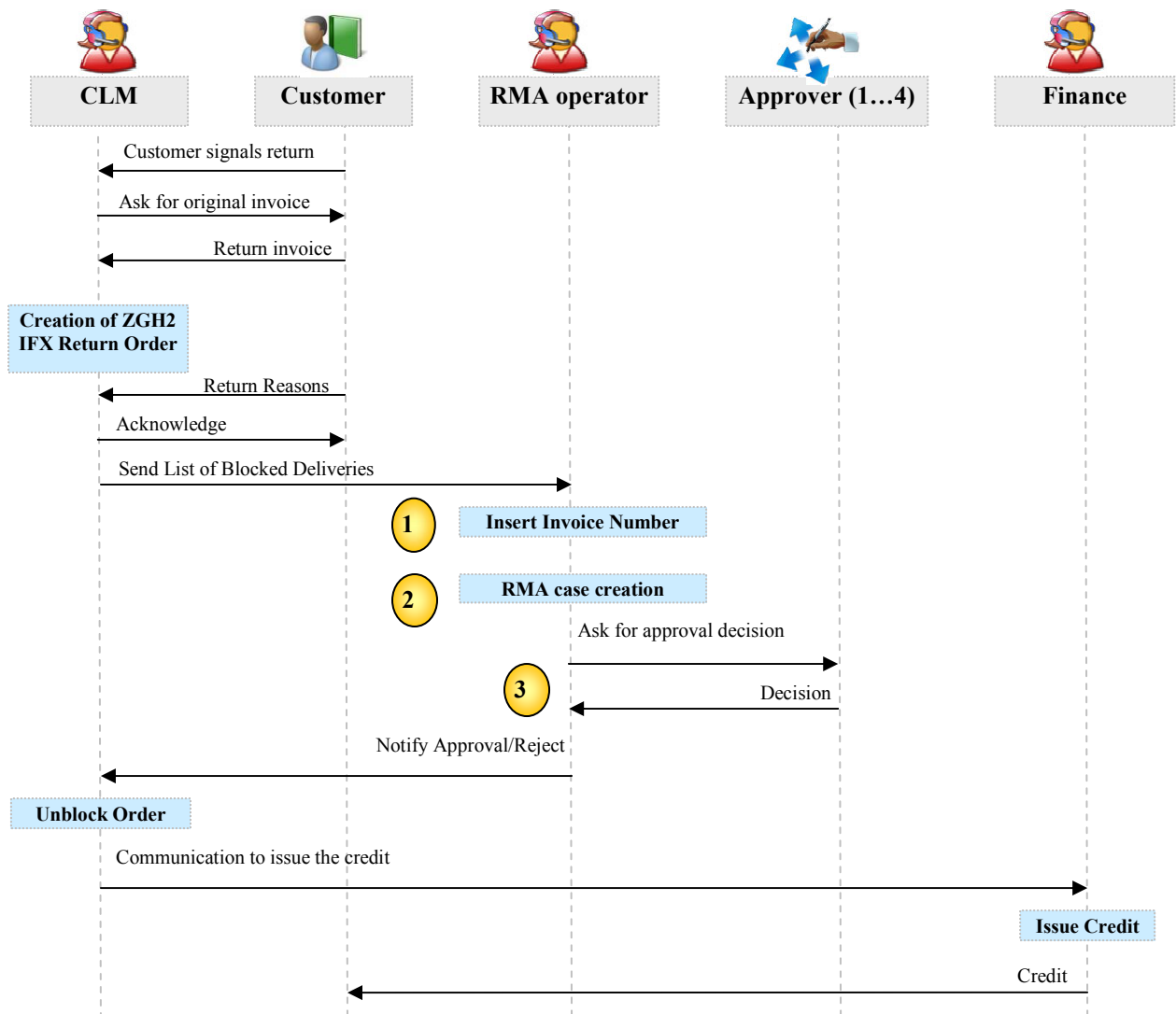
Figure 33: UML sequence diagram of the current procedures at QNA QM

At the point number one of the diagram, the "in use" solution has an advantage over the first developed solution: it only needs the invoice number (then all the relevant data is automatically obtained) while the first solution needs manual creation of a notification structure in SAP, which represents a higher effort for the user. But the biggest disadvantage of the first developed solution is shown at point 2: the approval loop is a manual process (user has to create individual approval tasks for each approver), while the current procedure in RMA provides a fully automated approval loop where the emails are automatically sent to the

right responsible approvers (system decides automatically based on the return value). At the point three, there is also a disadvantage: the decision verification is manual in the first developed solution and automated in the RMA.

Those fails were pointed by the QNA QM collaborators as critical, as it would increase the complexity and user effort. After reviewing all the process, a second solution called "enhanced solution" was designed.

The development of the enhanced solution had the objective of researching improvements to address those issues and to research other optimizations which could turn it a clearly winner solution.

The technical development of this new solution includes several improvements such as an automated approval loop, an improved data insertion in SAP QM and several other optimizations and automatisms to eliminate its weak points. The technical details are stated in the Appendix 8 and their cost is evaluated in the next section.

3.2.2.1   Implementation Plan

This enhanced solution was built on the experience obtained with the cooperation with the business client and its feedback. The developments suggested represent the optimal solution; still they might not be all implemented simultaneously due to possible budget constraints, as they can be considered enhancements (i.e. they cannot be included in the product lifecycle management). So as a consequence, it is important to classify the developments according to their pertinence and importance (table 12).

As this solution represents an enhancement upon the first one, this implies the implementation of the first one in order to implement the new solution afterwards. This means two things:

- The new solution will be more expensive;
- The implementation is more extensive;
- The new solution will have an increased complexity over the first one.

These three topics are inevitably true, and in practice this means the implementation will need more man days (higher budget), will take more time, and is more susceptible to errors than the first one (risk).

To this time the user involvement shall be conducted in a much more optimistic way:

- *Confidence*: we have to transmit to the people we are confident in this new solution, that it is really the right solution due to the many advantages it has and the improvement it represents over the other solutions;

- *Easy*: the amount training needed for this solution is low, and with the many enhancements made, it is really easy;

- *Quick*: it will save time, because it is optimized, straightforward and automatic;

- *Automatic*: a lot of effort was put on discovering the points the first solution had to improve. They were identified and it can be said that this solution does almost everything without the user intervention;

- *Almost "Non-SAP"*: SAP fear has to be reduced.

Table 12: Improvement budget estimation

Improvement	Priority	Justification	Budget [M-D]
Creation of "RMA complaint Key"	High	Driver of all further improvements	0.5
Automatic "Client Reference Document/Date"	Medium	Less two inputs needed	0.5
Automatic "Required End Date"	Low	Less one input (two clicks)	0.5
Automatic N1 creation	Medium	Less one input (two clicks)	0.5
Problem Description Optional	Medium	Less one input needed	1
Automatic Put in Process	High	Streamline and User effort reduction. Less one input (short description).	2
Automatic Defect Qty	Low	Less one mandatory input	1
Automatic Approver Creation	Low	Not mandatory, but it would be a nice "plus" for reporting purposes	2
Automatic Creation of the approval tasks	High	Very important for reducing user effort and streamline the process	1
Task Programming	High	Important for status reporting purposed	1
Automatic Notify CM when task is answered	Medium	Important for speeding up approvals. Would be perfect to notify when all approvers answered.	1
Automatic case closure	Low	Just a plus	0.5
Analysis		Before development	1
Documentation		Important	1
Testing		Integration, unit testing, troubleshooting	2
Total Estimation			**15.5 ≃ 16 Man Days**

3.2.2.2 Resource Planning

Budget and Return

Assuming an average man day price of 550€, the development and implementation cost of this solution (15-17 man days) would be of 8250€.

Figure 34 illustrates this simple investment project analysis (considering a yearly average inflation rate of 2% and an IT horizon of 4 years), considering the assertions stated in the first solution budget and return.
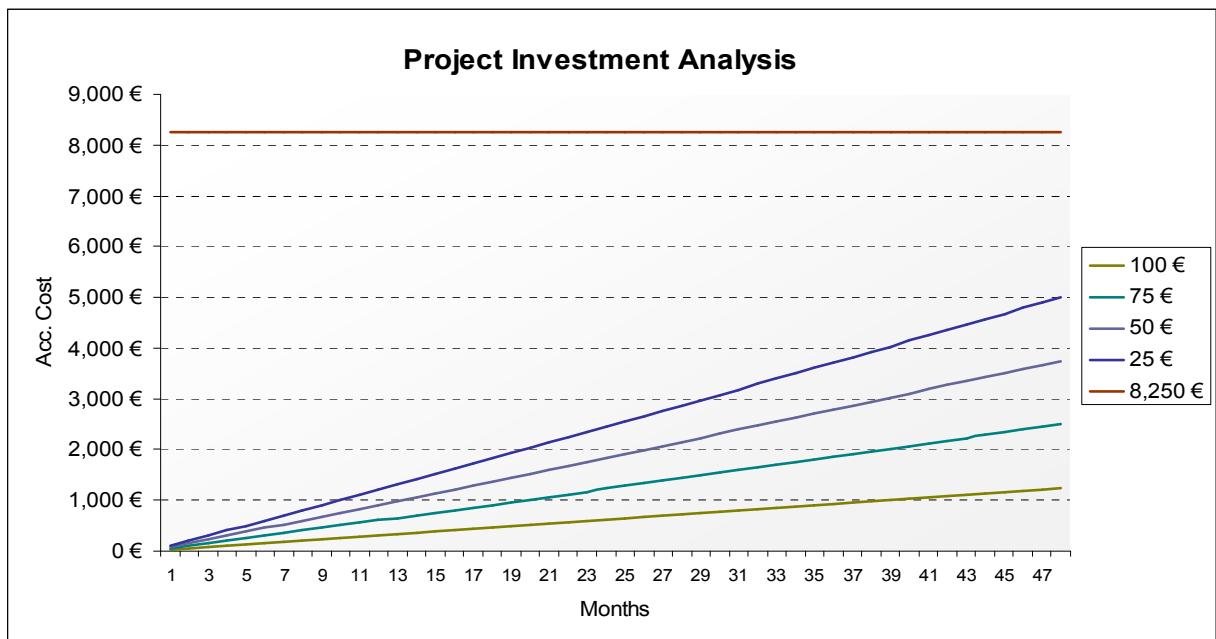
Figure 34: Solution Project Investment Analysis

The following conclusion can be extracted:

- Tangible and concrete breakeven won't happen in a 4-year forecast

Still, there are many other factors which will speed-up this time: increased automation reduces needed workforce, increased productivity, faster response time, global RMA reporting, data availability and consistency. So in terms of organizational financial benefits, we believe this solution will bring real benefits and it is well worth to implement it, although there is no concrete data to support this assessment.

Time

Table 13 shows an estimate of the technical implementation time range:

Table 13: Implementation schedule

Week 1					Week 2					Week 3					Week 4					Week 5					Week 6					Week 7				
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

1. Evaluation [Range: 5-10 days]
2. Request [Range: 1-2 days]
3. Evaluation [Range: 1-30 days]
4. Approval [Range: 1-5 days]
5. Project Scheduling [Range: 4-10 days]
6. Implementation [Range: 2-3 days]
7.Release

So, in the best case, the technical implementation will take 35 days. In the worst case, it will take about 74 days, considering that the release happens immediately after the implementation is finished. The end-user implementation time range shall not suffer any modification relatively the first solution.

<u>People</u>

The group of people needed to implement this enhanced solution is the same relatively to the first solution.

3.2.2.3   Benefit/Risk Assessment

There are some considerations that can be made about this enhanced solution:

- It has an increased level of automatism which turns it much more easy to use;
- The high effort put in reduction user of user effort makes it more fast straightforward than the first solution.

A forecast of the potential benefits and risks of the implementation of this new solution is not always a straightforward process, as its measure is as good as the assumptions it is based on. Nevertheless is worth to make its assessment. The table 14 shows all the considered factors:

Table 14: Benefit/risk assessment

Factor	Assessment	Benefit / Risk
Human Work needed	Automatic field input and approval email workflows.	High Benefit
Information available in making business decisions	Having all the decisions stated in SAP will allow a central reporting and consequently improve business decisions (external access to the RMA web portal doesn't work)	Benefit
Organizational Response Time	Automations decrease turn around times)	Benefit(Improvement)
Quality of results	The quality of results may be measured by their consistency, availability, reliability. As only one application is used by this solution, the consistency of the results is guaranteed as there is only one common database.	Benefit
Correctness of the Results	The new solution has higher degree of automation so every decision is made by the system. This greatly reduces the error chance. As user is more susceptible to error than an application, the correctness of the results presents a lower risk, in comparison with the first solution.	Benefit (Improvement)
Efficiency	Automation brings efficiency gains.	Benefit(Improvement)
Waste Reduction	User effort and waiting times are reduced now.	Benefit(Improvement)
Cost Cutting	Known cost cuts: support, maintenance and operation of RMA web application which includes hardware and software.	Benefit
Business compliance	Same as first solution.	Benefit
Security	Although SAP is a secure environment, any user with QM permissions can set the decisions prior to the complaint manager.	Risk
Budget Investment	Estimated Implementation time by Accenture: 13-15 man days, as this new solution involves ABAP programming, so it presents a higher risk.	Risk
Break Even time	As there are no financial details involved there is not the possibility of making break even forecasts, which increases risk.	Risk
Technical Conflicts	Conflicts are less likely to occur by using only SAP than by using SAP+RMA	Benefit
Feasibility	The implementation is feasible but difficulties are may arise in what concerns to the technical aspects,	Risk (more risk)
Operation / Change Costs	Same as first solution.	Benefit

3.2.2.4 Motivation

The motivation is the same relatively to the first developed solution.

3.2.3 Further Improvements and Process redesign

The new solution was presented to the QNA QM head: Ms. Christine Wyche. She considered that the solution had advantages, and considered a very positive improvement the fact of creating the return order just after the approval is the right procedure to do. It reduces waste of creating return orders which would not be used and would be kept in the system.

Christine Wyche also suggested the guidelines to drive further improvements:

- The approval loop has to be done for every return case. Then, we should be able to choose one of the two variants: it is technical complaint (N2) or a simple return with replacement/credit demand (N1). So, in theory the approval loop shall be included in the N0 notification level;

- The insertion of the delivery number shall be replaced by the insertion of the Purchase order number, as it is much easier for the CLM to insert it;

- The complaint manager shall not be set by default because the same person won't be able to manage all the cases;

- The approval loop must be sequential, not parallel;

- Changes should be allowed to the return price, as sometimes when a case that is approved (for a specific return value) it sees the price changed, as customer effectively returns a different value from the one it stated when complaining. This procedure must comply with SOX rules;

- An expiration date shall be implemented for the return cases (with deletion flag setting), because sometimes customers complain but they don't return any item, so the return cases keep are kept in the system virtually "forever" waiting for the return;

- Special handling of the "Replacement only" cases (0€ returns). The goal is to avoid the creation of 0€ return orders, but keep complaint traceability.

There are some statistics from which some conclusions can be extracted about the way to develop further improvements. The figure 35 shows the monthly-based Customer Returns in Qimonda North America.

As the light-blue line shows, there is a small (yet very significant) number of "created not received" RMA cases, which means those cases will be kept in the system virtually

"forever", thus wasting resources. The last three months steep climb may be due the extraordinary effect that some of the recently created cases have not been received yet.

	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07
■ Created Not Received	20	12	20	42	30	42	38	29	21	32	42	61	33	28	45	58	129	461
□ Received Not Credited	0	0	11	4	0	0	1	0	1	0	2	1	10	1	11	9	4	15
■ Credit Issued	650	745	633	827	698	1044	674	423	1016	672	894	715	844	743	806	710	487	397
Grand Total	670	757	664	873	728	1086	713	452	1038	704	938	777	887	772	862	777	620	873

Figure 35: Monthly Customer Returns at Qimonda North America

With the stabilized data (from May 2006 till May 2007) this data we can construct a table (table 15) which depicts the RMA creation in a year and extract the following conclusions:

The average number of total RMA cases created monthly is about 783. From these cases, about 32 are created but not received (4.3% of the monthly cases) while just about 1.5 are not credited (0.2% of the monthly cases).

So, by setting an expiration time range for the "created but not received" cases, we would save nearly 4.3% of storage resources straight away. If we look at these figures in a yearly basis, we can see that implementing that measure we would avoid the storage of 389 cases, which is quite significant.

Other less significant fact is the number of the received "not credited" cases (the cases in which a return order shall not be created), for only 0.2% of the total cases. So although it is be realistic to say those cases are not really important, as Christine Wyche stated, the way they are currently handled is not correct. So, for process correctness, all the return orders shall only be created if there is an approval.

Those figures are explained in table 15.

Table 15: Customer Returns at QNA

RMA Case Estimation							
	Created not Received		Received not Credited		Credited		
Month	#	% of total	#	% of total	#	% of total	Total
1	20	3.0%	0	0.0%	650	97.0%	670
2	12	1.6%	0	0.0%	745	98.4%	757
3	20	3.0%	11	1.7%	633	95.3%	664
4	42	4.8%	4	0.5%	827	94.7%	873
5	30	4.1%	0	0.0%	698	95.9%	728
6	42	3.9%	0	0.0%	1044	96.1%	1086
7	38	5.3%	1	0.1%	674	94.5%	713
8	29	6.4%	0	0.0%	423	93.6%	452
9	21	2.0%	1	0.1%	1016	97.9%	1038
10	32	4.5%	0	0.0%	672	95.5%	704
11	42	4.5%	2	0.2%	894	95.3%	938
12	61	7.9%	1	0.1%	715	92.0%	777
Total/Year	389		20		8991		9400
Av/Month	32.42	4.3%	1.67	0.2%	749.25	95.5%	783.3333

Christine Wyche also revealed that Qimonda North America needs an integrated complete solution, from the customer complaint till the resolution of the issue. That solution would integrate a web page accessible via internet on which the customers would make their complaint. A case tracking number then would be given to them and they would be notified of the cases resolution.

Although that solution is a broader solution and its scope is much broader than the scope of this project, it is worth to make a brief study of the hypothetical best solution for that problem.

3.2.4   The Perfect Solution

The integration of all the functionalities discussed in the previous point leads to the creation of a new solution. This solution may be called the "ideal" solution, an so there are many features which are not that feasible due several factors (budget, etc). Nevertheless they will be briefly discussed.

In order to include all the options previously discussed, a new process (depicted figures 36 and 37) is required.
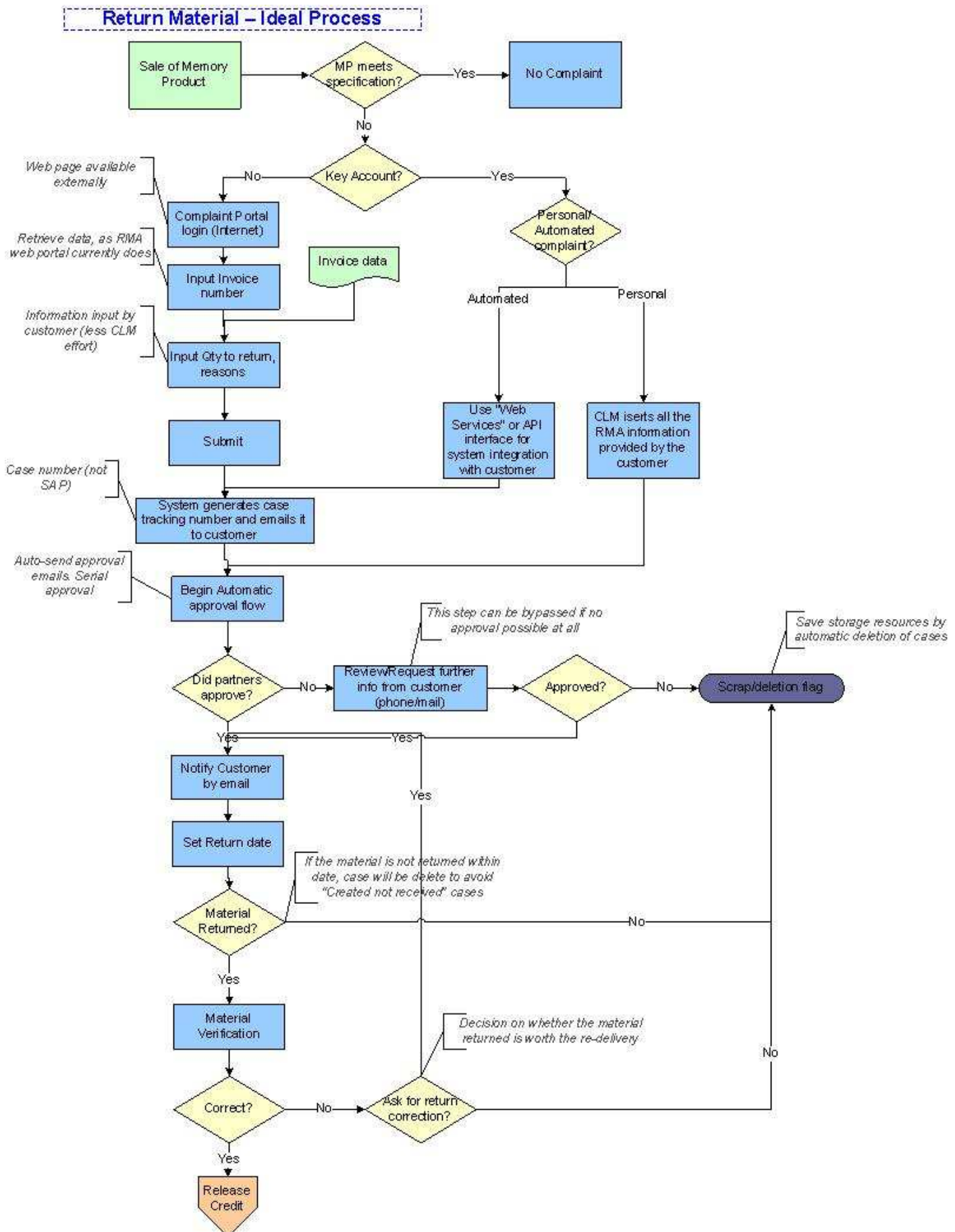
Figure 36: Ideal process (part 1)
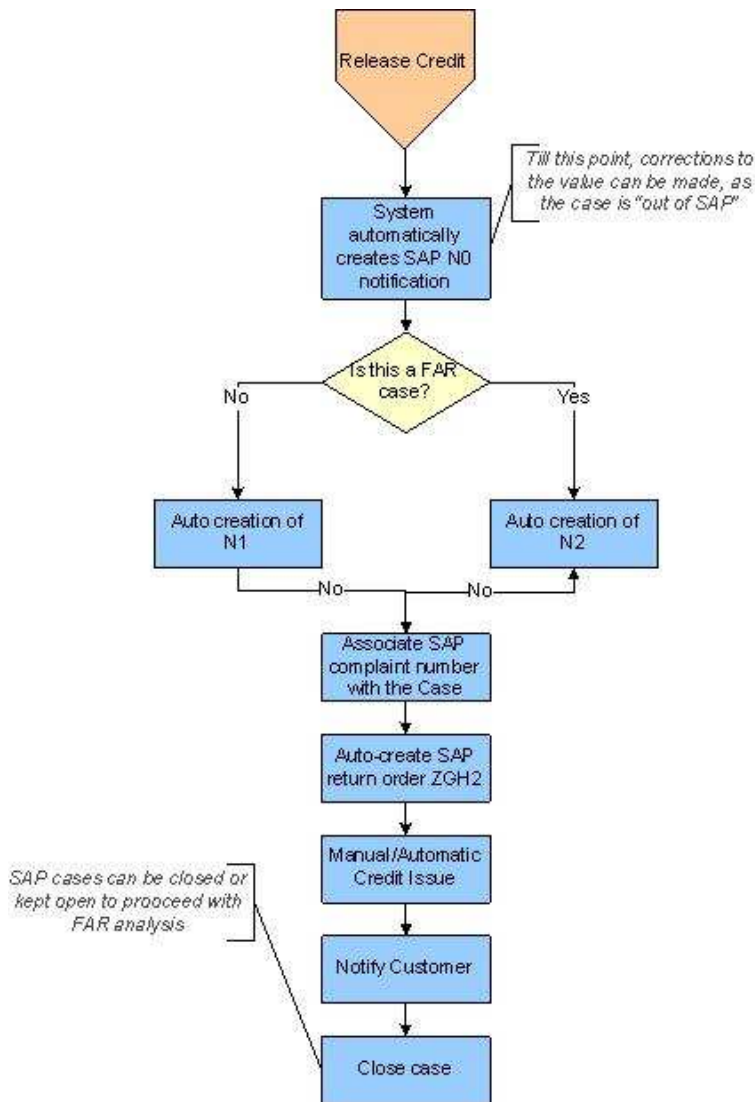
Figure 37: Ideal process (part 2)

This solution is just a suggestion which can be tailored to the specific desires of the client, in this case, QNA QM (or even Qimonda global QM). Every step of the process shall be evaluated together with the client, as this solution must not be imposed, but discussed.

This ideal process would not require a completely new IT landscape, but it would require the creation of a web portal for complaints, and integration with SAP QM/SD/GOAL.

The UML deployment scheme of figure 38 illustrates the new IT tool landscape.

Basically, it is SAP R3 Enterprise, together with a web application, with the three layers divided: client pc (interface), a web server with the business logic layer and a DB server with the database. The web server could also store the database, for example if we used JSP with Struts or Hibernate technology, but as there is a considerable number of RMA cases, there is the need of a powerful, reliable database (ex. Oracle) as this solution will be directly accessible by the customers, so it will influence the perception of quality of Qimonda services.
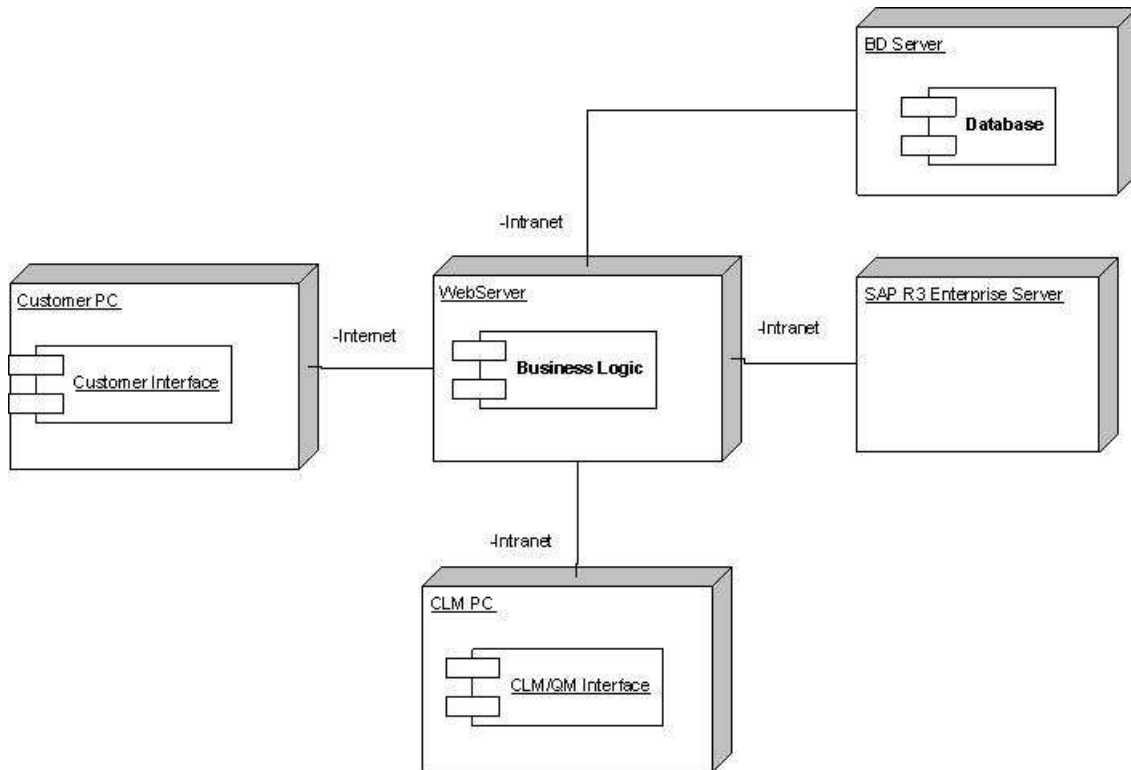
Figure 38: UML deployment scheme of the applications for the ideal solution

Brief evaluation

This ideal solution would be represent a big investment for Qimonda and it would cover sensible businesses (customer relations, quality management), which presents a higher risk. It is difficult to predict the cost of this solution and the resources involved, but it has a broad scope, so it is expected to be expensive. It would require a multidisciplinary team (business side people, web and SAP developers) and very serious approach in the IT area, with definition and discussion of the requirements directly with the business side, and prepare for an iterative development process, as requirements and features will have to be redesigned/improved/changed/tuned, according to the result tests.

Table 16 compares this ideal solution with the previous ones:

It may be concluded that the solutions described in the precious sections can be implemented in a near future due to their simplicity, although if real process improvements were needed to be implemented, the ideal solution is the one to go for. Nevertheless, it requires a much higher budget and resources, so it is a solution that shall be discussed and planned in order to be implemented in the long term.

Table 16: Solution Comparison

Factor	First and Enhanced solutions	Ideal solution
Scope	RMA approval – RMA web portal Replacement	Complete Return Material process since complaint to credit
Risk	Lower	Higher (sensible information)
Cost	Lower	Much Higher
Development Time	Lower	Much Higher
Performance	Improvement over actual RMA approval solution	Great Improvement with amplifying performance gains along the whole process chain. Broader scope, higher gains.
Integration	Benefit	Benefit: only a web application and SAP for whole process
User Effort	Benefit - automation	Higher benefit: less phone calls and CLM input (will be done just for "key accounts"), several automated mechanisms, automatic deletion flags, etc. Great reduction in user input in all steps.
Waste reduction	Significant	Great
Complexity	Lower	Higher

3.3   Phase II - Analysis

The phase II does not present any improvement point as the ATT application was already studied and integrated in SAP in the previous internship developed by the student.

3.4   Phase III - Categorization

Following a business request to assess the possibility of migration of the Catbrow application into SAP and/or bring its support to the QPT IT PA AS group, a study was made. The results shown that is not worth to integrate it in SAP. The following section explains this study in more detail.

3.4.1 Catbrow application – What to do?

Analysis

This application used in the categorization phase was also made an investigation to assess if there was margin for further improvements. Along this investigation, two things became apparent:

- The application is not being used only in the Customer Returns Process, but also in other quality process (production quality and product engineering);
- The application is quite well integrated inside the Customer Returns process and doesn't raise any determinant criticism.

The first fact means *"do not touch it without talking with all the application user groups"*. But this fact has other consequence: if the same application data is used by other groups, then it makes no sense to split the program into two parts: one used by the CR, and one used by the other processes. This would increase waste, as the same data flows and storage had to be duplicated, and this is not a very lean approach. One hypothesis would be to migrate this application to SAP and merge it with the PSI (Part Specific Information) in the N2 notification. This would allow the visualization of the test results together and categorization. Still, this approach would not be realistic, as 3 of the 4 user modes the application has are "non-customer returns", which means that this migration would not take in account their functions. Being so, this approach is not feasible.

Other hypothesis would be to migrate the whole application to SAP, by creating a completely new transaction. The benefit would be the obvious one: less one application server, less maintenance and operation costs. Nevertheless it would be the only benefit: no data integration benefits could be extracted: an own set of tables would be needed to import the data from LPC. We would have two choices here: import the LPC data in a batch job basis (would need much higher storage space as data as long as 6 months has to be kept) or in real time (data parsing would be needed). In addition, the CR categorization results would have to be sent to the N2 notifications, too. So, there are not enough advantages to consider Catbrow SAP integration a "must".

The second fact is a consequence of the program's logic architecture: by importing data from LPC Fabtools, it connects itself to the Phase 2 (analysis) of the Customer Returns process, allowing the data to flow from phase 2 to Phase 3. By exporting the categorization data to SAP, it also connects itself to the beginning of phase 4 (Quality Improvement Initiatives) of the Customer Returns process. So this makes the data to flow correctly along the process by integrating the several parts of the chain.

Catbrow is a simple and efficient application, and it supports a set of quality processes (not only the CR processes) which rely on the same test data. It makes no sense to split it or to integrate it elsewhere, because it is already integrated. It may not have the same technology type of LPC or SAP, nevertheless it allows a perfect data flow.

The pareto categories are common to the 4 user modes and can (and shall) be used for all the user modes. The analysis of the pareto categories statistics that will be obtained in EBS will be represent a significant improvement to extract conclusions about the most common fails for each product.

<u>Realistic Possibilities</u>

Catbrow is a stable application, supporting stable and efficient processes. Nevertheless the questions "Can we bring the Catbrow support to the QPT IT PA AS team?" and "How can we do it?" are always justified.

In what concerns complexity, Catbrow is quite simple. It has a simple database (with a few tables), its interface is simple, the data it receives from LPC is not complex and the data it sends to EBS is really simple: just a text file with a defined parameter order. The communication with SAP would be easier as in QPT IT PA AS team there is SAP Knowledge. So the support would be a feasible option. QPT IT PA AS team members have a wide group of knowledge backgrounds and that is an advantage, as they can deal with a wide number of technologies and processes, and extract synergies of their distinct knowledge. So I consider this is a very feasible option. Nevertheless, it is true that many times the application support and ownership is related to political decisions inside Qimonda and that would be probably the main obstacle.

This work and analysis also serves as a good basis for a quick handover of the support of the studied applications, as it provides a lot of integrated knowledge.

So, I think it is a feasible ambition for the QPT IT PA AS team to get the support of the application, what would bring benefits to the application users.

3.5   Phase IV – Quality Improvement Initiatives

The phase IV does not present any improvement point as the CRI application was already studied and integrated in SAP in the previous internship developed by the student.

3.6   Phase V – Closure and Reporting

The phase V does not present any improvement point as it refers only to the closure and reporting of the case.

3.7   Containment actions

3.7.1   Diagnosis and brief evaluation

Diagnosis

As it was stated in previous chapters, the containment actions can be implemented at any phase of the Customer Returns process (although usually they are mostly implemented at the registration phase, or even before). It was also stated that there are several kinds of containment actions, each one may be related to a specific action upon several areas of the supply chain and although they have different means and objectives they should act together when needed in order to contain the spreading of defect products or erroneous procedures.

The containment actions processes sometimes contain references to each others, and many times they may interact. As an example, a Special Clearance case may override a SRD case as it is considered to have a higher precedence. They may also be enter in conflict: a quarantine action states that the production of a certain material shall be stopped immediately, but some experimental lots which were not intended for shipment were shipped (through a special clearance case) for a key account to check their validity. If this happens who has the highest precedence? Is the SC case or the QMR?

It is also a reality that the software applications which support the containment actions should use a common source of supply chain data in order to be perfectly integrated and to interact. By comparing the technologies and architectures of those applications, it is easy to see that it is not happening at all, as table 17 shows.

Table 17: Containment Action applications technology comparison

Application	DB	Technology	Type	Interfaces	References
SRD	SAP DB (Oracle)	ABAP	Batch	SAP R/3	
SPI	RDC (Oracle)	ASP	Real time/Batch upload to SAP	SAP R/3 PGI, PGS+	
AVL	RDC (Oracle)	ASP	Real time	SAP R/3 PGI, PGS+	
QMR	ASP	ASP	Real Time	None	SC, Material Blocking
SC	Lotus Notes	Lotus Notes	Real time	None	QMR, Lot Management

Although there is only one supply chain, each one of these applications uses its own database (with exception of the SRD application which was already migrated to SAP). This increases data inconsistencies and waste (resources, time, communication overheads, etc). They also have different technologies which are not straightforward to integrate (ASP integration with SAP ABAP technology needs a middleware communication layer, and Lotus Notes web applications are not commonly integrated with other technologies).

Other fact is that containment actions should be viewed as a set of related actions and not as independent actions, because each of their subprocesses references the others too, so

they are all interconnected. Therefore, the problems found in the containment action processes can be summarized:

- Containment action support application developed in very different technologies, using different sources of data, replicating data, using different interfaces and data conversions ("batch/real time" systems), which causes waste of resources, lack of data integrity, lack of data integration;

- Processes not integrated, because the support applications don't allow that integration;

- The consequences of these two facts are the higher quality management expenditure with wasted resources, longer TAT times (thus degrading quality perception of Qimonda by their customers), non-streamlined processes, lack of integration, loss of efficiency, higher user effort and headcount needed to execute them.

There is clearly an improvement opportunity here.

Possible Solutions and Evaluation

Although now the improvement point seems to be clear, some of the business groups which execute the containment actions had already noticed that their applications should be developed in order to solve some of those problems. Nevertheless, although those individual developments could lead to more efficient applications, it would not solve the lack of integration between each other, so the problem would remain basically the same.

There is the strong conviction that the real and significant improvement can only be achieved if all the containment action business groups and IT supporters sit together at the same table to establish the priorities and make an integration roadmap for the applications. A strong and persistent commitment from all parties would be needed, as it will probably require a medium/long term approach. It would require a lot of IT planning, with the definition of the communication interfaces, data conversions, databases, migration schedules, debugging and a continuous risk assessment and minimization, as these processes represent vital processes for Qimonda, and the minimum disruption of their availability would have serious tangible and intangible consequences.

In a more concrete view, the steps that should be taken to improve the actual situation are:

- As a first phase, integrate of the SC, AVL and SPI applications in SAP (as it is the main information system at Qimonda, already supporting other QM and Sales, Material Management processes). SRD transaction has to be developed to be in compliance with SAP R/3 real-time architecture (it currently works in batch mode due to implementation problems). SPI functionality should be merged inside the SRD transaction in SAP, as its function is very similar, and it could be integrated with minimum effort;

- PGS+ connection could be shutdown by making full use of SAP Material Management Module;

- SC application shall be integrated in SAP by using the quality notifications (without making any interface connection yet). So the actual functionality would remain the same at this first phase;

This would make those applications to share a common database and a common technology, although not yet being fully integrated between each other. Other benefit would be that waste would be reduced through the shutdown of their servers. The 1st line support could also be done by the IT PA AS instead of having different teams dealing with different technologies. QMR, by being a more complex application, would be left to the second phase. Nevertheless a plan of the integration work had to be already done. At the end of this phase the situation of the applications should be as shown table 18.

Table 18: Containment Action applications technology comparison after the first phase

Application	DB	Technology	Type	Interfaces	References
SRD	SAP DB (Oracle)	ABAP	Real time	SAP R/3	
SPI	SAP DB (Oracle)	ABAP	Real time	SAP R/3	
AVL	SAP DB (Oracle)	ABAP	Real time	SAP R/3	
QMR	ASP	ASP	Real Time	None	SC, Material Blocking
SC	SAP DB (Oracle)	ABAP	Real time	None	QMR, Lot Management

Then, the second and final phase could begin:

- SC application should be integrated in SAP by using the quality notifications (without making any interface connection yet). So the actual functionality would remain the same at this first phase;

- QMR should include a new connection to SAP data: connection to Material Management for lot tracking in real time, connection for the QM module in order to allow the creation of orders to set up new SC/SRD/SPI cases as needed. It is not clear, though, if QMR application should be included in SAP due to it specificities. It would work as a "new business layer and web interface" for the SAP database and would be responsible for the functionalities related to its actual process specifications;

- By including some routines on SAP which would monitor the status of the AVL qualifications, it would automatically send emails suggesting containment actions to the responsible people (ex: if a product qualification status changes to "Disqualified", alarm emails should be sent in order to quickly react to that change;

- SC application would extract data from the QMR cases when needed, as it currently only uses the hyperlink reference of the relevant QMR cases. This would represent a big improvement, as it would also interact with the QMR cases;

- SC application would allow the execution of the special delivery through a new task;

- The SC and the SRD/SPI application relation would be defined in terms of "precedence": SC cases would override all the SRD/SPI rules.

At the end of this phase, the application table would suffer changes (table 19).

Table 19: Containment Action applications technology comparison after the second phase

Application	DB	Technology	Type	Interfaces	References
SRD	SAP DB (Oracle)	ABAP	Real time	SAP R/3	
SPI	SAP DB (Oracle)	ABAP	Real time	SAP R/3	
AVL	SAP DB (Oracle)	ABAP	Real time	SAP R/3	
QMR	SAP DB (Oracle)	ASP/ABAP (if inside SAP)	Real Time	SAP R/3 MM (lot tracking), QM (SC cases creation), SD (Delivery blocking)	SC, Material Blocking
SC	SAP DB (Oracle)	ABAP	Real time	SAP R/3 and QMR	QMR

As it can be seen, all the applications would share the same database and technology, what would be fundamental for further improvements and integration.

So the final objectives for this improvement process are:

- To achieve a fully integrated and optimized IT application landscape for the containment action implementation;

- Integrate the data in a common platform to avoid replication issues and resource waste;

- Find new SAP solutions to support the migration of the functionalities from the SC, AVL and SPI applications;

- Establish the basis and guidelines for an integration roadmap for the containment action applications and processes, in order to involve all the stakeholders and systems.

3.7.2 Solution 1 – Migrate SC application to SAP QM

Although this is an individual application, it is relevant to focus its integration in SAP in a higher detail degree due to the fact that the business side has already suggested its integration in SAP QM as it is the backbone of the quality management at Qimonda. Among other functionalities, it provides the quality notifications which presently handle the complaints made by external customers or internal entities about logistic/technical (product defects)/other problems.

SAP is also a flexible system which can be customized and developed to fulfill changing requirements or new business needs. The quality notifications can be extended to support also the Special Clearance cases, which basically consist in the execution of approval flows regarding any request for the special clearance of items which are not intended to be shipped, due to several reasons (experimental or defect lots, for example). With a creative approach and some development work, there is the conviction that SAP quality notifications can perfectly support the integration of the current SC application functionalities in SAP.

The approval loop can be handled by the automatic execution of approval tasks (as already seen at the improved solution for the RMA application) and the documentation and risk assessment (needed to justify the request for the special clearance) can be performed, stored, and then shared by recurring to the Document Management System control of SAP.

The DMS (Document Management System) of SAP allows a quick organization, edition, storage and share of files. It can be configured for every type of file (even email files) and it consists of an embeddable control which can be used by several transactions of SAP for document management. It can be embedded inside a quality notification to provide it its powerful document management functionalities.

A hyperlink connection for the QMR case can be input within the document management system. (This point shall also be improved in the second phase, with the creation of a connection to the QMR case). The big description field may be used to input the reason for the SC case and all the necessary restrictions/considerations about the referenced lots. The lot list may be inserted in the DMS, through the edition of the lot file (the template shall be contained in the DMS and automatically created blank for each new notification case). The risk assessment already performed shall be uploaded also to the DMS control in order to be shared with the approvers. The SC applicant inputs also the material type.

When the case is set-up the SC applicant shall chose the SC Manager (it can be himself if desired) in the partners area and change the notification status to "Publish".

Then, the SC manager will be notified through an automatic email and an automatic approval loop will automatically begin (similar to the RMA enhanced solution one). This approval loop is a serial one, which means that the emails will be sent one after each other for every approver (automatically chosen by SAP system according to the SC approval matrix contained in the process specification). The approvers approve through the web form, in the same way as in the RMA solution. If all approvers give their approval (manual assessment of the approvals), the SC manager shall proceed with the case and distribute the SC info to all the relevant parties, in order to execute the dispatch of material to the customer, implementing or not any other Quarantine measures (this is an improvement point for the second phase: connection to QMR).

Through these actions the case can be closed, by changing the case status to "archive". Once put in "archive" status, the case cannot be changed again. The technical development of this solution is described in the appendix 9.

3.7.2.1   Implementation Plan

The motivation from the business side is a fact (as it was the business side that suggested and asked this assessment of the SC migration to SAP). Nevertheless, there is the need to involve all the related collaborators to assure that a possible transition is made with success. Some testing shall be done first, in order to assure it complies with the expectation of the client and has the desirable levels of correctness, performance, and user acceptance.

The budget forecast and prioritization of this improvement is presented in table 20.

Table 20: Budget forecast and improvement prioritization

Improvement	Priority	Justification	Budget [M-D]
SAP SC Notification customization (including DMS)	High	Base of the SC case in SAP QM	4
Automated Approval loop (implementation of the approval matrix and responsible people)	High	Driver the automatisms (approval loop matrix, etc)	3
Automated "inform inventory management" email destination selection	Medium	Good to save time to the SC manager	1
24h Tat check automated mechanism	Medium	Good to assure Tat accomplishment as stated in the definition	1
ABAP screen painter job to change some custom screen controls	High	Needed to comply with the SC semantics	1
Task Programming	High	Needed to implement communication with other containment action areas, business sectors, etc	3
Analysis		Before development	3
Documentation		Important	5
Testing		Integration, unit testing, troubleshooting	3
Total Estimation			**24 Man Days**

An approach to the user implementation plan would comprise 5 phases:

- Present the improvement program and review each improvement with Bernhard Wiehler;

- Define with Bernhard Wiehler a group of test users;

- Define the documents to produce for training (initial and further learning): Quick start guide, user manual;

- Training;

- Obtain feedback and include it in the specification for the second phase containment action improvement.

3.7.2.2 Resource Planning

Budget and Return

Assuming an average man day price of 550€, the development and the average implementation cost of this solution (24 man days) would be of about 13200 euros.

Figure 39 illustrates this simple investment project analysis (considering a yearly average inflation rate of 2% and an IT horizon of 4 years), based on the same assumptions made in previous studies:
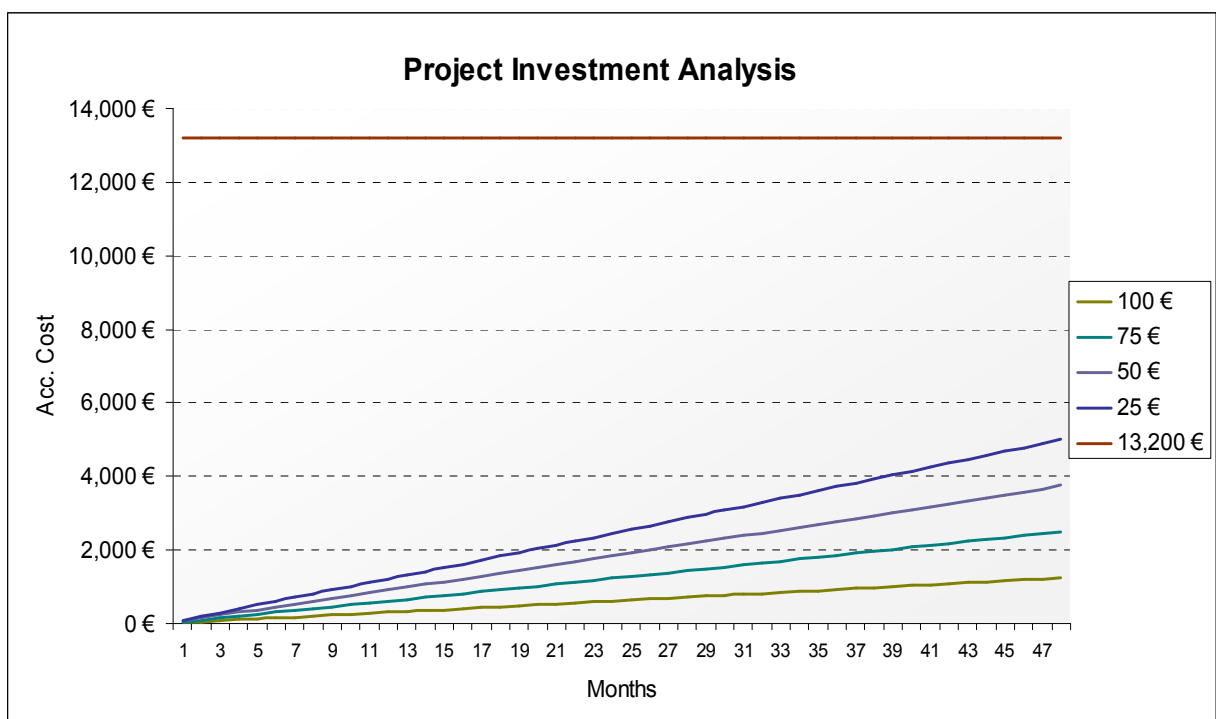

Figure 39: Solution Project Investment Analysis

It is possible to extract the following conclusions:

- This is a rather expensive project, in comparison with the implementation of the RMA improvements, for example;

- Breakeven will not happen in the first four years after implementation, if the server price per month ranges between 25 and 100 euros (having in account only tangible factors like the server cost);

- Nevertheless this study doesn't have in account other factors that cannot be included, such as increased productivity, faster response time, reduced process entropy, SC integrated reporting in SAP, data availability, reliability and consistency.
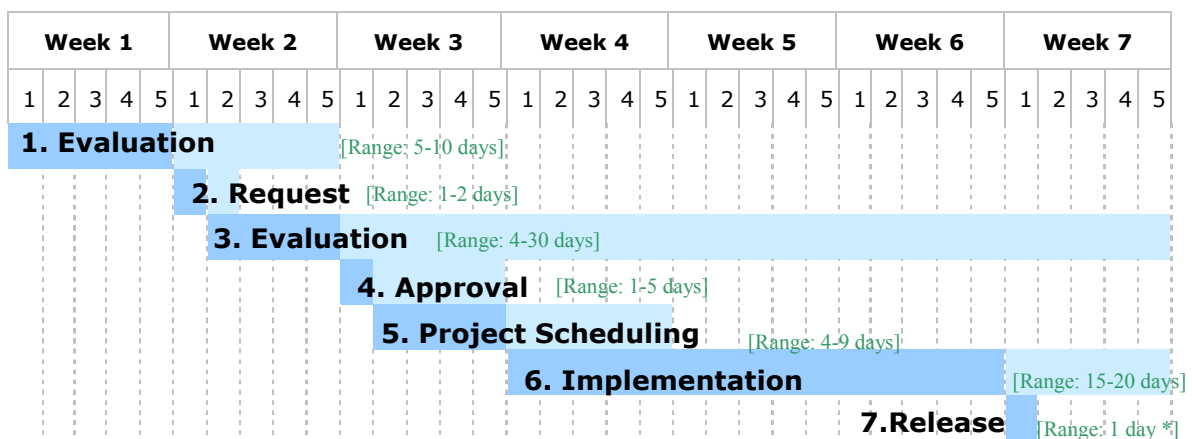
The cost of this project can be explained by the high number (and somewhat complex) automatisms that need to be implemented, and due to the fact that SAP QM notifications need to be tuned and modified to accommodate the SC functionalities.

A factor that can make this project less expensive is the fact that some of the ABAP developments it needs are almost exact copies of the RMA ones. So in fact, implementation synergies can be extracted though code reuse. Considering this factor, the cost of the project implementation can be 1/3 less of the forecasted.

Time

Table 21shows an estimate of the technical implementation time schedule:

Table 21: Implementation schedule

Week 1					Week 2					Week 3					Week 4					Week 5					Week 6					Week 7				
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

1. Evaluation [Range: 5-10 days]

2. Request [Range: 1-2 days]

3. Evaluation [Range: 4-30 days]

4. Approval [Range: 1-5 days]

5. Project Scheduling [Range: 4-9 days]

6. Implementation [Range: 15-20 days]

7.Release [Range: 1 day *]

* Releases are usually scheduled to the third Thursday of each month

People

The following table lists the people needed to implement this project:

Table 22: People needed to implement the SC migration to SAP QM

People	Function	Responsibility
Implementation Team	Implement the solution	Accenture
Test Team	Test the solution; bug report; improvement suggestion	Bernhard Wiehler
QPT IT PA AS	Coordinate and manage all the improvement process	QPT IT PA AS

3.7.2.3 Benefit/Risk Assessment

Including the SC functionality inside the notification structure of SAP QM is advantageous. But the main advantage is the preparation for the second phase of the containment action improvement, which would integrate all the separate pieces (applications) in the (containment actions) puzzle, making them work together, in a perfect integration. So this may be considered just the first (and necessary) step.

Tables 23 and 24 make an assessment of the risk/benefit of the migration of SC to SAP.

Table 23: Risk/benefit of the SC migration to SAP QM (part 1)

Factor	Assessment	Benefit / Risk
Human Work needed	User will be using only SAP (one application, less application changes) though it has to make a personal decision on the signoff parties.	Benefit
Information available in making business decisions	Risk assessment documentation share would be quite enhanced with the DMS functionality. All the information needed for the material dispatch would be included in the email. The other task enhancements would also bring information availability benefits.	Benefit
Organizational Response Time	Decreased organizational response time, as the process gets simplified and more rule compliant. Tat monitoring its deviation would be notified.	Benefit
Quality of results	The quality of results may be measured by their consistency, availability, reliability. As only one application is used by this solution, the consistency of the results is guaranteed as there is only one common database. The availability and reliability of SAP is widely recognized also.	Benefit
Correctness of the Results	No improvement	Irrelevant
Efficiency	Only SAP being used: SC application will be shutdown, so there is less an application to support, less waste, less data communication, data conversion, less one database.	Benefit
Waste Reduction	Reduced waiting as the process is simplified and Tat times reduced.	Benefit

Table 24: Risk/benefit of the SC migration to SAP QM (part 2)

Factor	Assessment	Benefit / Risk
Cost Cutting	Known cost cuts: support, maintenance and operation of SC web application which includes hardware and software.	Benefit
Business compliance	Same	Irrelevant
Security	Although SAP is a secure environment, any user with QM permissions can set the decisions prior to the complaint manager.	Risk
Budget Investment	Estimated Implementation time by Accenture: 24 man days.	Risk
Break Even time	Not in the next 4 years. It is risky, but it has plenty of non-tangible advantages which shall pay financial dividends in the future, though the break even time can be reduced by extracting implementation synergies with the enhanced RMA improvement.	Risk
Technical Conflicts	No.	Irrelevant
Feasibility	The implementation is risky. There are some advanced improvements which require skill and testing. People change resistance is under control, as this is a business-pushed improvement.	Risk
Operation / Change Costs	SAP can be customized to accommodate new business demands. Operation costs decrease, as SC costs are cut.	Benefit

3.7.2.4   Motivation

IT Side

The implementation of this solution as a part of a future QM roadmap makes sense, as it will be a step forward in the complete integration of the containment actions of the Customer Returns Process. The process will become trimmer and more efficient, while saving costs in almost every aspect.

IT will have to support fewer applications, less complexity as the process would become unified and the support could be done at just one location. The SC support would not be needed anymore, so QPT IT PA could support all the process as it is and SAP project, demanded by Bernhard Wiehler to QPT IT PA. So it is logic QPT IT PA AS to be "awarded" with its support.

Business

This is a reactive (but still creative) approach towards the improvement of the quality processes, as it was demanded by the business side. Business is receptive to change, what is always good.

3.7.3   Solution 2 – "Two phased" plan for containment action software integration

By observing the actual IT landscape that supports the containment actions, it was possible to conclude it does not provide the proper integration level, as its applications are made up of disjoint technologies and databases. This is probably the result of years of an individual business groups approach, where each application was possibly planned "individually", not taking in consideration its relations with the other business-related applications. This caused the applications to be developed separately, without any logic communication interface specification between the applications.

For a further QM IT roadmap, the integration of the containment actions shall be a priority, although its cost and resource expenditure may be very significant.

One possible and feasible approach (considering the actual economic background of Qimonda) would be a two phased plan, which would be implemented in a mid-long term (3-4 years). Of course, with a strong commitment from the Qimonda top management this time could be reduced to one year or so, but in the foreseeable future developments won't be allowed or encouraged, as Qimonda tries to stabilize its financial situation by cutting capital expenditures. My personal opinion is that the containment actions improvement won't be considered to be "high priority developments" by Qimonda's management (and I agree it's not critical for Qimonda survival at short-term, too). Even when Qimonda's background gets better, higher priority developments will be started first. So, for all those reasons, a 4-year implementation time is a realistic target. Nevertheless a consideration shall be made about the implementation time: the longer it is, lesser will be the business process compliance, as the processes change throughout the time. Nevertheless some prevention measures can be taken in order to assure business compliance at the time the solution starts working at the productive environment:

- Re-definition of the individual containment actions process specifications according to the most recent data and according to business forecasts, with wide scope parameters (to give flexibility to the processes to accommodate possible business changes);

- Plan an incremental and iterative application development, with periodic revision of the processes (yearly), in order to assure its compliance. This revision shall be made by the business side, i.e. the business side shall report any process changes to the IT development team. Discussion on whether and how the deviations shall be included in the development shall be done together.

Being so the four-year two-phased plan for implementation would comprise the following actions:

- Phase I: Integrate the individual software applications in a common platform and technology through functionality migration, keeping the same functionality level (2 years):

- Individual process redefinition, forecast for the next five years with wide scope parameters, performed by the business side. This would comprise the revision of the process documentation, approval matrixes, process interaction, etc. (1 year);

- Analysis and specification of each application redesign and migration to SAP (in the case of the SC application, RDC-AVL and RDC-SPI). SC shall be migrated to the quality notifications as previously described. QMR requirement analysis and specification shall make an assessment of the possibility of migration to SAP MM and SD area or not, in order to implement advanced features which are not yet present (ex: automatic lot tracing). (6 months);

- Specification and documentation of the communication interfaces between each application in a standard way. (6 months);

- Migration of the SC, AVL and SPI applications to SAP. QMR development. Testing for user acceptance, business process compliance, result correctness. User documentation elaboration. PGS+ communication with RDC shall be shutdown and SAP shall be used as the only source of data to the AVL and SPI applications.(1 year).

- Phase II: Integrate the individual software applications in a common platform and technology through functionality migration. (2 years)

- Communication establishment between the recently migrated applications to SAP, through the implementation of the communication interfaces already defined at the first-phase. (1 year);

- Global testing, further improvements to comply with business changes (1 year).

The technical implementation of this solution is not the focus of the project specification. Nevertheless the specification of the data interfaces between the applications is included in appendix 10.

3.7.3.1 Implementation Plan

This two-phased containment action improvement plan was planned to be feasible, and was based in several organizational a business inputs. Basically it can be described in a few words: Phase one: "migrate", phase two: "integrate". Being so, the economic aspects, human aspects and process aspects were weighted. Nevertheless it is a plan with a high extension (and with high inherent costs as well) which will only advance it the top management considers is a priority. Nevertheless much of its approach and study basis may be used for further improvements, by the amount and diversity of information that it summarizes and brings together.

Table 25 prioritizes its implementation actions and makes a forecast of the time (in development Man-days) that will be needed (having in account the actual organizational constraints). This forecast is not scientific, as it cannot be measured accurately, as this is a

very big plan and any serious forecast has to include several factors that cannot be included in this project.

Table 25: Forecasts of the improvements include in the two phased plan

Improvement	Priority	Justification	Budget [M-D]
Individual process redefinition	High	Fundamental for process compliance of the applications in future. Will guide all the developments to be made. (phase I)	0 (performed by the business side)
Analysis and specification of applications redesign and migration to SAP	High	Fundamental for the implementation (phase I)	0 (performed By IT PA AS)
Specification and documentation of the communication interfaces	Medium	Fundamental for the integration, but not mandatory for the migration in the phase II). (phase I)	0 (performed by IT)
Migration of the SC app. to SAP	High	Basis for phase II. (phase I)	24
Migration of the AVL app. to SAP	High	Basis for phase II. (phase I)	15 (forecast)
Migration of the SPI app. to SAP	High	Basis for phase II. (phase I)	20 (forecast)
QMR migration to SAP/development (with lot tracing features implementation)	Medium	If the management decides not to get into phase II for economic reasons (i.e. if the management decide to execute phase I just to shut down the application servers by migrating the applications to SAP), this will have lower importance, as it may be developed out of SAP. (Phase I)	60
Implementation of the communication interfaces	Medium	Phase II	30
Further improvements	Low	Decision up to the management	0
Documentation		Important	10
Testing		Integration, unit testing, troubleshooting	20
Total Estimation			**179 Man Days**

With a development time of about 179 man days, this is a very expensive improvement. If we look at the table we can conclude that if we only invest in phase I (application migration to SAP and server shutdown), it would cost 59 man-days (excluding QMR investment, as it would only be needed for a second phase), which may not be considered that expensive considering the number of applications migrated. This phase is the one which may generate more "tangible" benefits: the application servers shutdown.

However, in terms of global benefits, this would not bring much benefit, as the integration between the applications and the processes would not be done.

So the phase I will cost about 33% of the total budget but would only bring about 20% (server shutdown) of the total benefits. Which means the phase II, although expensive, its well worth by its benefits (continuous data flow, waste removal (waiting time, communication times, etc), faster quality processes response time, integration with the rest of the Customer Returns processes and with Qimonda supply chain data, better user experience with all the automatisms proposed, much higher efficiency, less support teams, less entropy, etc)

3.7.3.2   Resource Planning

Budget and Return

Assuming an average man day price of 550€, the development and implementation cost of this solution (179 man days) would be of 98450€.

Figure 40 illustrates this simple investment project analysis (considering a yearly average inflation rate of 2% and an IT horizon of 4 years), making the same server cost assumptions of the improvements discussed in the previous sections.
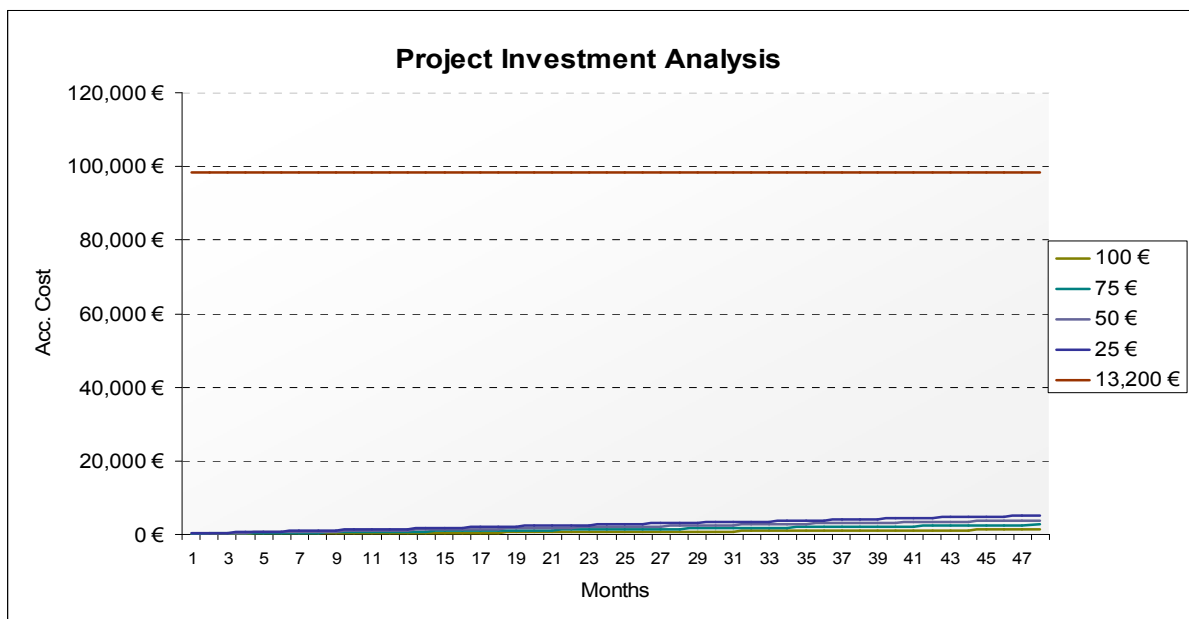

Figure 40: Project investment analysis

So we can extract the following conclusions:

- Tangible and concrete breakeven won't happen in a 4-year forecast;
- Tangible benefits would account for 5% of the investment.

Still, there are many other factors which will speed-up this time: increased automation reduces needed workforce, increased productivity, faster response time, global reporting, data availability and consistency. So in terms of organizational financial benefits, we believe this solution will bring real benefits and it is well worth to implement it, although there is no concrete data to support this assessment.

Time

As this project is a big project, it's not possible to make accurate estimations, as their assessment is out of scope of this project. Nevertheless we assume a timeframe of 4 years.

The time estimates were obtained considering the request falls in a "low priority" category and being so, every phase take much longer than if it was considered a high priority improvement.

People

The table 26 illustrates the people needed to implement this project.

Table 26: People needed to implement the two phased plan

People	Function	Responsibility
Implementation Team	Implement the solution	Accenture
Test Team	Test the solution; bug report; improvement suggestion	Several teams: one team per business group
QPT IT PA AS	Coordinate and manage all the improvement process	QPT IT PA AS

3.7.3.3 Benefit/Risk Assessment

Executing this two-phased approach would bring huge benefits to Qimonda QM:

- Shorter response times in implementing containment actions, which would avoid shipment of defect products to customers (waste reduction, process optimization);
- Less communication delays and overheads between people and business groups (waste reduction);
- Less servers and support teams needed (waste reduction);
- Integrated data, easier data access, real time data access (process optimization);
- Less user effort: basically an "only SAP" solution, so it would have only one interface, one authentication;
- Integration with the supply chain;
- Integration between the containment actions in a logic flow;
- Lean approach to the processes.

A forecast of the potential benefits and risks of the implementation of this plan isn't a straightforward process. Tables 27 and 28 show all the considered factors.

Table 27: Benefit/Risk assessment (part 1)

Factor	Assessment	Benefit / Risk
Human Work needed	User will be using probably only SAP (one application, less application changes), depending on final assessment of QMR integration possibilities. User interaction need reduced. Automated and logic information flow between containment actions, one interface.	High Benefit
Information available in making business decisions	Increase of information available in making business decisions, as all the information will be in the same platform. The information exchange between the several applications would be quite improved through the implementation of the communication interfaces.	High Benefit
Organizational Response Time	Much decreased organizational response time, lower TaTs.	Benefit
Quality of results	The quality of results may be measured by their consistency, availability, reliability. As only one application is used by this solution, the consistency of the results is guaranteed as there is only one common database. The availability and reliability of SAP is widely recognized also.	Benefit
Correctness of the Results	The new solution has higher degree of automation so every decision is made by the system. This greatly reduces the error chance. As user is more susceptible to error than an application, the correctness of the results presents an lower risk, in comparison with the first solution.	Benefit
Efficiency	The new solution is much more efficient: brings a simplified and uniform process by putting all the containment actions working together.	High Benefit
Waste Reduction	Reduced waiting as the process is simplified; reduced data transport (only one database); reduced underutilization of IT infrastructures as current applications would be shutdown. User effort and waiting times would be reduced.	High Benefit
Cost Cutting	Known cost cuts: support, maintenance and operation of current applications which includes hardware and software.	Benefit
Business compliance	Higher	Benefit
Security	Although SAP is a secure environment, any user with QM permissions can set the decisions prior to the complaint manager.	Risk
Budget Investment	Estimated Implementation time by Accenture: 179 man days, as this new solution involves a lot of ABAP (and possibly other technologies) programming, so it presents a higher risk.	High Risk

Table 28: Benefit/Risk assessment (part 2)

Factor	Assessment	Benefit / Risk
Break Even time	As there are no financial details involved there isn't the possibility of making break even forecasts, which increases risk.	Risk
Technical Conflicts	Conflicts are less likely to occur by using only SAP than by using SAP+RMA	Benefit
Feasibility	Depends on financial situation of Qimonda and will of the management.	High Risk
Operation / Change Costs	Costs of integration, operation, change ("*What happens if business changes?*") are can't be estimated. But SAP can be customized to accommodate new business demands. Operation costs decrease, as well as support costs.	Benefit

3.7.3.4 Motivation

IT Side

The implementation of this solution as a part of a future QM roadmap makes sense, as it will be a step forward in the simplification and unification of the global Customer Returns Processes. The process will become trimmer and more efficient, while saving costs in almost every aspect.

IT will have to support fewer applications, less complexity as the process would become unified and the support could be done at just one location. Probably QPT IT PA could support all the processes, although it would need more people.

Business

As this is a pro-active approach towards the improvement of the quality processes, business (and essentially management staff) has to be told that this improvement is significant and will bring the benefits stated in the previous table, but emphasizing the simplification of the IT landscape, processes, improvement in end-user experience and time savings, reduction of waiting, etc.

4   Conclusions

Since the beginning, this project was developed in tight cooperation with several business groups worldwide, in order to make it fully successful. In five months, an endless number of documents were analyzed and discussed together with the business groups not only to understand the theoretical concepts behind the processes and applications but also their use in the reality of the enterprise.

The student read several books, articles, process specifications which were summarized and were useful to the proposal and assessment of innovative solutions. These solutions were presented to the business groups, evaluated and tested. The result of his hard work is visible in this report and can be summarized:

- The Customer Returns process was analyzed in a deep and open-minded way: every subprocess, people involved, conditionings, software applications were studied. There were many documents produced, which will be very useful to increase the enterprise knowledge on its own processes;

- RMA integration in SAP QM was studied in detail, and several possible solutions with different benefit/risk relations were made and developed. The responsible people inside Qimonda may decide which solution to implement;

- The integration of SC in SAP QM was studied, developed and evaluated in detail;

- The integration of the containment actions applications was studied and a two-phased plan was developed and evaluated. The implementation of this plan will change the containment actions application landscape described in figure 41, where the applications use different technologies and do not communicate between them, to the fully integrated application landscape described in figure 42.
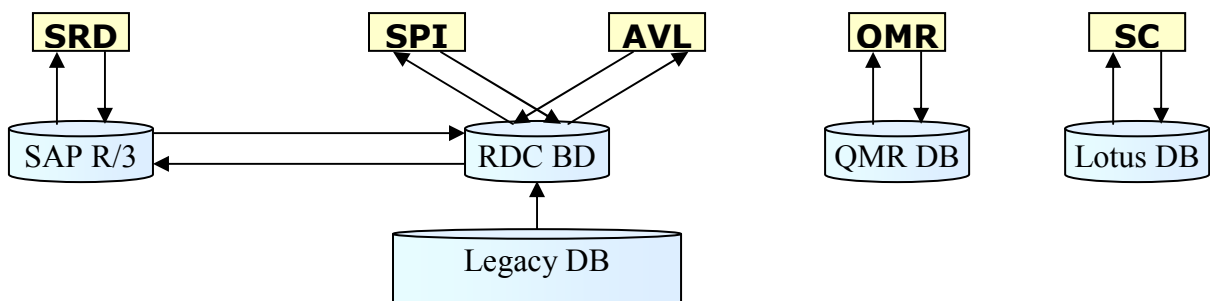

Figure 41: Current application landscape in the containment action area
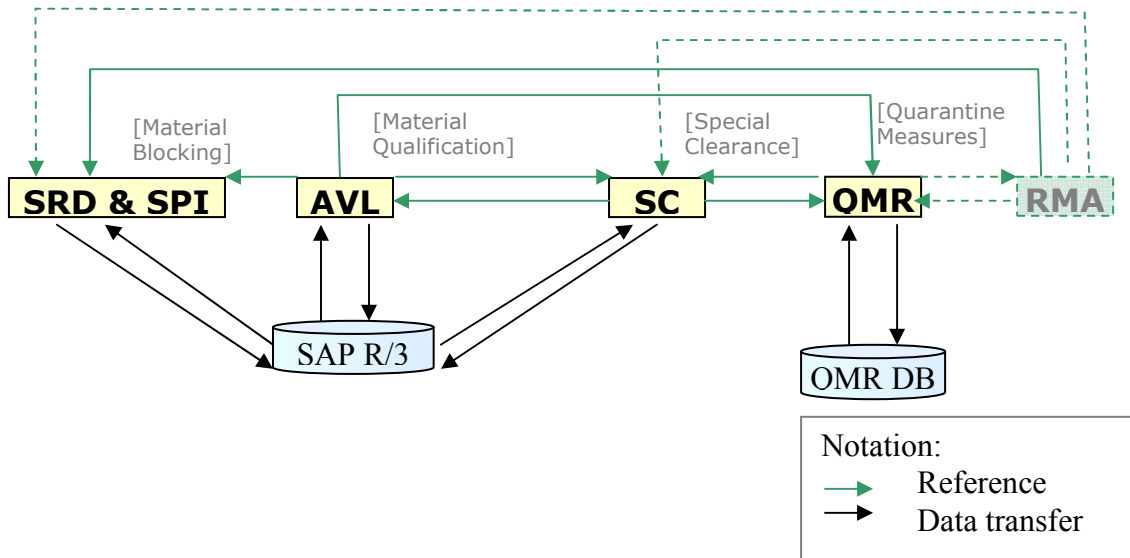
Figure 42: Future application landscape in the containment action area

As it is possible to see in figure 42, the implementation of this plan will connect the applications, allowing them to communicate, being in fully compliance with the processes specification. The number of databases is reduced, which brings integration benefits, by eliminating redundancies, data replications and inconsistencies.

- The study of the integration of Catbrow concluded that is not worth to include it in SAP QM.

At the end of this project, it is possible to say that it was advantageous both to the student and to the enterprise where the project was developed:

- To the student, this project was a highly enriching experience at professional and personal levels. The opportunity to work in a big multinational company, to study its processes, to conceive new solutions which will be implemented in future was a great achievement. Being in a multicultural environment increased the social and cultural competences of the student, who always had to care about human factors to assure the success of the project. Throughout the internship, the student was encouraged t to have a creative and mature vision of the enterprise processes and this was a great contribute to the personal development;

- To the enterprise this project was very beneficial, as the project results will be useful to streamline its processes and increase the quality of its software applications. This project will surely bring tangible competitive advantages, by making its processes more lean, accurate, trim and efficient.

This project was a "win-win" relationship between the student and the enterprise, and it will open a window for new developments.

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