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ABSTRACT

In this paper we made a comparative review of two case studies in development, design, and implementation of in-house custom-designed Enterprise Resource Planning packages in manufacturing and services. For comparison, we scanned through business solutions, tangible and intangible benefits, process of implementation, implementation problems and planning, benefits of ERP implementation, business processes, business strategies, project goals, IT infrastructure, and key critical success factors (KCSFs). The KCSFs and the important key factors were the focus point in evaluation of differences. For instance, in manufacturing, the innovation strategy was identified as an important KCSF in implementation planning phase whereas in service, understanding client business processes was identified as an important KCSF in planning phase.

INTRODUCTION

In the course of the 1990s, ERP systems evolved when the functionality of MRPII in production was blended with other applications concerning quality, maintenance, marketing, sales, personnel and various other support activities. Thus, ERP systems moved away from the manufacturing environment to support of the entire manufacturing company and from there to the support of service companies as well. These changes in functionality and application environment have had an important impact on implementation processes for these systems. There is a voluminous literature on implementing ERP systems, which has resulted in an increasingly long list of critical success factors. There is little systematic attention, however, for the question if implementation requires different approaches if it takes place in a services environment instead of a manufacturing environment.

Inspired by some implementation failures in a services environment, we have carried out a systematic review of the literature on this issue. First, we have compared the literature on MRP implementation with the literature on ERP implementation. Since ERP is supportive of many more service elements in the manufacturing environment, we expected some first clues from this comparison. Furthermore, we have compared the literature on ERP implementation before 2000 with that after 2000. Before 2000, implementing ERP was most frequently tied to solving the Y2K problem and solving various other problems with legacy systems, whereas this is most certainly less so after 2000.

Again, we expected this comparison to give us a clearer view on differences in implementation requirements between manufacturing and services. In our review we looked at differences in the reasons for ERP adoption (including project goals, business objectives) and differences in project routes (project phases) and key critical success factors in implementation between manufacturing and services. Our investigation shows that some differences can indeed be identified that appear to be related to the inherent differences between manufacturing and services.

We conclude that, compared to a manufacturing environment, implementation in a services environment needs to be less technology oriented, more bottom-up and more concerned with external integration with customers (Salimi, 2005; Salimi, Dankbaar & Davidrajuh, 2006).

In contrast to off-the-shelf ERP implementation, there are not much literature available in the process of custom-designed ERP implementation and the differences of these packages in manufacturing and services. This lack of literature and practitioners explicit knowledge motivated the reason for elaborating the process of custom-designed ERP implementations in these two case studies in manufacturing and services. The objective of this paper is to take this unique opportunity to evaluate the hands on custom designed implementation of ERP in manufacturing and services. We followed the same route as earlier researchers in search for identification of critical key success factors in the process of MRP and ERP implementations. We have reviewed literature comprehensively for KCSFs in two sectors in preceding ERP articles (Salimi, 2005; Salimi, Dankbaar & Davidrajuh, 2006).

For a shortcut reference to KCSFs, we have provided the reader with the following section in KCSFs as below.

The case studies were conducted by project leader (β project manager) and key participant (α HR manager) in ERP development and implementation. The methodology was the collection of tacit knowledge during hands-on participation, and brainstorming teams of different or relevant disciplines in both firms by the key participants.

Key Critical Success Factors (KCSFs)

This section is concerned with the KCSFs used in industry practice. KCSFs can determine whether the ERP implementation will be successful. There is a large literature on KCSFs based on the traditional method of identifying KCSFs such as in the project management body of knowledge (PM-BOK). Similarly, there is a large literature on KCSFs based on the same traditional method of identifying KCSFs in ERP implementation. These KCSFs are the pressure points in IT projects. We used the approach to finding KCSFs, which has been applied in industry for a long time. The KCSFs bridge the link between ERP implementation and improvement in business performance across strategy, business processes, IT, structure, culture and management systems. ERP KCSFs demonstrate the linkages between ERP critical factors of success, ERP success and ERP benefits (Al-Mashari et al., 2003). The KCSFs are the well-deployed visions and missions that have been translated and communicated at all levels within the organization. How well the KCSFs are relayed into the organization is a major condition for the ERP systems to yield the desired benefits (Lyytinen & Hirschheim, 1987).

KCSFs determine whether the ERP implementation will be successful.

A number of authors have identified a variety of factors that can be considered to be critical to the success of an ERP implementation (Umble et al., 2003). Nah et al. (2003) stated that the high failure rate of ERP implementation called for a better understanding of its KCSFs (Somers et al., 2000). Nah et al. (2003) identified eleven KCSFs from an extensive literature review and then she used this result as a benchmark to evaluate the survey of Chief Information Officers' (CIO) perceptions of the degree of criticality of these KCSFs in ERP implementation. Nah et al.'s (2003) identification of the KCSFs and their citations by ERP practitioners point to knowledge accumulation and convergent opinions of both academics and practitioners.

A number of researchers have identified KCSFs in the process of MRP implementation (Chen, 1996). In a comparative analysis of MRP II implementation and ERP implementation, researchers have also identified the KCSFs prior to the millennium change (Cramer, 1998).

Their research suggested differences in KCSFs between MRP implementation in manufacturing and ERP implementation in manufacturing and services such as project related tasks, contingency approach to ERP implementation, contingency approach to interfaces, outsourcing ERP implementation tasks, application of simulation cases, and the importance of continuity of team members in ERP implementation projects (Kylstra, et al., 1997).

In the period of around the millennium change with the related software problems, a number of scholars also focused on identification of KCSFs in the process of ERP implementation (Al-Mashari, et al., 2003).

The differences in KCSFs between ERP implementation and MRP implementation routes appear to be due to (a) incorporation of a service section in ERP, (b) higher requirements for project management skills (c) the invisibility of the project route. The intention of the literature review was initially to compare and analyse the findings of various researchers in different ERP projects across all industries.

We review the development phases in two case studies in implementation of in-house enterprise resource planning software packages in manufacturing and services in post Y2K period.

Case Study α

The **_α_**-group is a firm of accountants, fiscal advisers, management consultants, financial and legal advisers. Since 1948, α has been consulting clients in optimising their financial position, business reporting, business operations and fiscal planning. The clients market consists mostly of wealthy entrepreneurs, their firms, professionals and wealthy private individuals.

_α_ is a service-oriented firm with 140 employees consulting clients at personal and professional level. The new organizational structure (implemented in January of 2002) consists of a board of directors with HRM, ICT and administration as supportive organs. The firm's success relies on the knowledge, skills, commitment and devotion of its personnel. In this case study, we critically
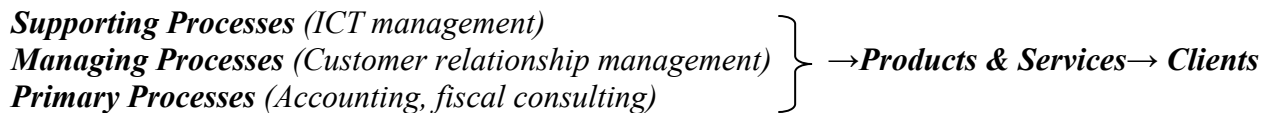
analysed and evaluated the practical implementation of custom-designed ERP software, *α*-net, at client's facilities (Ω b.v.).

Business solutions

In 1997, *α* launched a research and development plan to customize the labour intensive services of making annual reports. *α* developed a CaseWare (audit-agent) program to its own-custom-designed ERP system for to automate the process of annual report. This process of annual report automation later extended to annual budget, monthly reporting and consolidated annual reports. In the course of six years, the preliminary in-house software programme was developed to a serious custom-designed ERP application program fitting well with *α* business processes. However, the users had to change their working process to adapt to the new system. Furthermore, IT infrastructure had to be restructured to accommodate the new application and provide sufficient speed for a smooth operation.

By the introduction of *α*-net, the organization marketed a new service in consulting to existing and potential clients. This change in Product-Market-Combinations (PMC's) had the benefit of synchronizing all internal processes of supporting, managing and primary processes for serving optimal products and services to clients, Figure 1.

Figure 1: New Internal Processes (also see Table 2).

Supporting Processes (ICT management)
Managing Processes (Customer relationship management) } *→Products & Services→ Clients*
Primary Processes (Accounting, fiscal consulting)

With the implementation of *α*-net, *α* invested in its internal and external (re) sources. The internal investment included the opportunity costs and the capital costs (ICT applications). *α*-net changed the traditional role of the accountant to a new role as a professional consultant. The staffs were professionally trained in consulting skills.

A new personal relationship was developed between the accountant and clients. *α*-net demands for more frequent contacts with the client. The weekly interim reports offered the opportunity to build a stronger relationship with the client. In addition to its support to the organizational objectives, other benefits of *α*-net to upstream and downstream processes were also identified. Among other (post) implementation impacts, *α* discovered the new role of the accountant: as consultant, close to the clients who can understand the client´s position on real time basis.

Prior to the actual *α*-net implementation, management team anticipated the *α*-(post) implementation impacts on the organization, its internal processes, and its personnel.

Tangible and intangible benefits

α now benefits of the new system in non-financial data processing of the financial data using a balanced score card method (Figure 2). The consultant states that the click and mortar system had better results in building personal relationship with the client than any other available

systems. *α*-net is a custom-designed CRM tool building a tight relation with the client. In general, the primary processes provided more options in management consulting.

The managing processes emphasized a stronger relationship with the clients, while the supporting processes were heavily dependent on ICT.

Figure 2:   *α*-net new CRM structure.
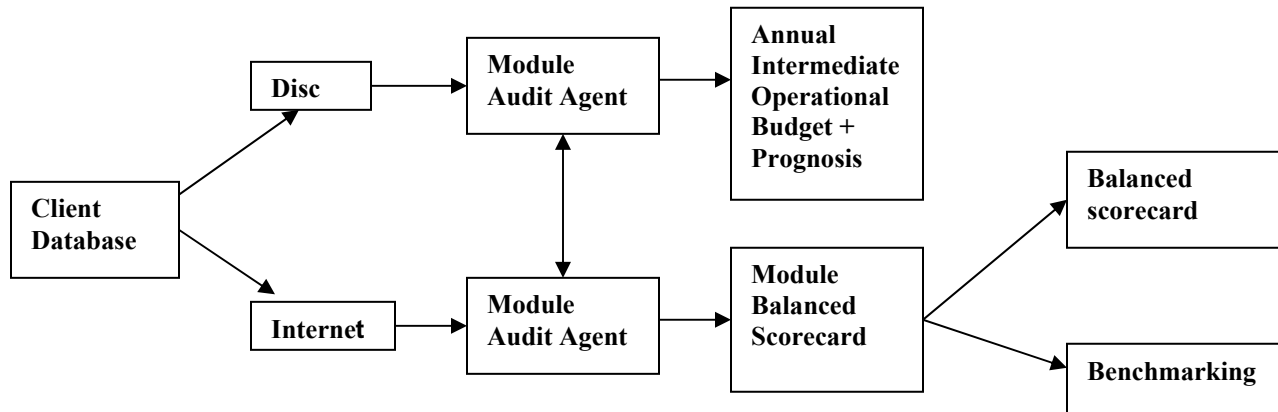
Process of implementation at α

The implementation of *α*-net and its integration with client IT facilities required business re-engineering (process optimization) of internal processes at *α*. The Audit Agent Module generated various financial intelligence data. Periodically, *α* read the client database through two different applications: Internet service provider (ISP) and floppy disc. By using these applications together with specific client models, *α* not only improved the intelligence gathering from the client but it also accelerated the whole operation. For example, it was possible to generate weekly, intermediate, reports in comparison to earlier monthly or quarterly reports.

In this context, *α*-net extended its application to generate non-financial intelligence by processing the financial data in a balanced scorecard module. *α*-net uses EDI* (Electronic Data Interchange) in its data transmission.

α Implementation problem definition at a client site

α-net was introduced to the client, Ω BV, to support the firm's planned expansion. The client, Ω, is a production firm with two main shareholders. It has fifty employees and an annual turnover of approx. seven million euros. The firm operates in the metal business and it has expanded strongly over the past few years. This expansion was on production of metal parts on stock, and building machines. These machines, however, are not produced on stock but just-in-time upon client order. Ω was determined to continue expanding in the coming years. It looked for opportunities to enter the global market, but this required an expansion of its range of products. However, this was not the biggest problem. The firm was immediately confronted with the following problems. Ω needed additional credit to finance its planned growth. The bank did not

provide any financial means, unless it had a better and more detailed insights in the current and planned financial state of the firm.

The agreed delivery times were often exceeded; insufficient intermediate insight was available into the exact financial position and the performance of the various business units. The number of employees working at the financial department was limited. Based on these problem statements, Ω approached α for a business solution. α proposed its business solution implementation plan to Ω (Table 1).

Implementation plan

α planned and implemented a hardware and software application to migrate the data from the Exact Financial Database at the client site. α followed the implementation procedure for IT integration in the course of a one-year implementation plan. α identified several advantages that α-net brought to its client and to α. α-net not only had an impact on the primary processes, but it also changed the role of accountant as a service provider and consultant close to the client. The new accountant was not a person who just put the numbers in the right place at the right time. The new role of the accountant was consultancy: close to its clients with real understanding of the clients' requirement. This has always been one of the Unique Selling Points of α. While α-net is a customized application program, in order to market this product to the market, α had to advise its clients with the following considerations in implementation, (a) The α-net application must fit well within into the firm strategic vision, (b) A solid base in ICT-structure is a must, (c) New developments in application must be continuously monitored and incorporated into α-net, (d) The client should follow the use of e-commerce within legal parameters, and (e) The client should understand the application of new PMC's and its impacts on the internal processes and organizational performance. We sketched these changes and its impacts on three new synchronized business processes, i.e. primary, managing and supporting, due to ERP α-net implementation at α in Table 2.

Application and techniques

α applied several tools as well as internal and external expertise in order to carry out the project at Ω b.v. The tools of great importance to α-net were:

o   Sumatra-satellite from Sumatra: the Sumatra-application makes it possible to approach the Exact-database of Ω;
o   Audit-Agent from AudIT Benelux: the application AuditAgent makes it possible to easily transform the data from Exact to various necessary reports (intermediate reports, budgets, etc.). In order to implement this solution, α developed specific client models in Audit-Agent;
o   Balanced Scorecard from EFQM: this application makes it possible to name the various indicators in the Balanced Scorecard by using the necessary data from Exact.

The application of the technical tools depends on the way data acquisition takes place: (a) By direct modem connection logging into the client's system (from a distance), (b) By dial back connection and password authorization. There has to be agreements on periods to log in (entrance). The client as well as α log in to the Internet. α will search for the specific database to

download the data by using the fixed or variable IP-address from the client; α receives e-mail with an attachment for the administration data. The data acquisition applies through the following security measures: firewall security and changing the password regularly.

Table 1: Implementation plans at the client site, Ω.

Step	Description	Time
1.	Restructuring the administration. The organization of the administration left too little possibilities to generate the necessary management information. There were also doubts about the validity of the current data. Therefore it was decided to restructure the administration with the support of α during 4 months. The objective of this new structure was to generate: Valid financial interim reports per business unit; A balance sheet and profit- and loss account; Performance- and cash flow figures per Product-Market-Combination (PMC).	July 2xxx-Dec.2xxx; 6 months
2.	From the available intelligence of step 1 a short-term cash flow prognosis was drafted.	December 2xxx
3.	To draft a long-term cash flow prognosis, more intelligence is needed. In order to control the growth, a business plan is made. Ω and α worked out the idea of going global in more detail. With the available intelligence of step 1 (concerning the PMC), it was decided to eliminate a number of (not very profitable) products.	Nov. 2xxx-Dec. 2xxx; 2 months
4.	The business plan and the available financial reports were discussed during a meeting with the creditors. On the basis of this intelligence the bank decided to provide the financial means for the Ω long-term growth.	Nov. 2xxx-Dec. 2xxx; 2 months
5.	With the the bank approval, Ω could accomplish the planned growth. Ω realized that this growth could not be maintained, unless the business processes and the administrative support were restructured. α redesigned and restructured these elements. The conditions were made that Ω could keep handling the financial administration herself. Next to this, Ω did not want to allocate more resources (employees) to extend the financial department. During this stage α-net, the virtual controller of α, was introduced at Ω.	Dec. 2xxx-Feb. 2xxx; 3 months
6.	In order to measure the performance of the various business units, the Balanced Scorecard was introduced. This made it possible for the business units to obtain different types of intelligence on: Financial performance; Performance towards clients; Internal performance; Performance on the ability to learn and innovate.	March 2xxx
7.	On behalf of the managers of both business units, the digital dashboard is introduced. The report of the digital dashboard is available for the managing directors, on paper as well as on e-mail. In the near future this will also be available through a secured extra-net.	April 2xxx
8.	Currently, α generates weekly (interim reports) to monitor the business of Ω. Daily the α accountant, the virtual controller, logs in through internet to look at (and when necessary react to) the database of Ω.	April 2xxx–present Continuous process

Table 2: The change management impact in post implementation period at *α*.

Primary processes	*Events*	*Consequences*
1. Accounting	Client Financial Administration Compose annual reports Consultancy on business economics	Client does its own financial administration Generating intermediate reports periodically with provision of data from internet. Virtual controller offers more options in consulting
2. Fiscal consulting	Fiscal tax forms Fiscal advice	None
3. Pay roll	Pay roll administration clients	None
4. Other	ICT Advise Legal advice	Opportunities in consulting by integrating the current systems None
Managing processes		*Consequences*
Customer relationship management		Less frequent personal contact with clients but accountants gained even closer relation with the client.
Supporting processes		*Consequences*
ICT management		More heavily dependent on ICT, extra measures to be taken on: reliability, privacy and redundancy of operation.

Benefits of α-net (post) implementation to client (Ω bv)

Since July 2xxx, business processes at Ω bv has improved considerably. The intelligence dissemination improved and accelerated. The improvement provided transparency to the bank and stakeholders and a better control by the consultant. By partnership with *α*, Ω saved costs in its financial management operation and the same time boosted the Ω image to its potential clients and new skilled talents.

Case Study β

β is an international manufacturing firm with an annual revenue of twenty one million EUR (which is 10% of the two hundred million EUR AGV systems market) in Europe and the U.S. β services companies to optimise their internal logistics. β employs seventy employees and it is one of the largest AGV system manufacturers worldwide. The Automated Guided Vehicles Systems (AGVS), transport system, is the 'core and the main end-product' of β. β core business is software development and industrial automation with AGVS as the main final product. βwas founded in 1984 when a logistics study led to the development of the 'Free Ranging On Grid' (FROG) concept for navigating with AGV's. β offers a supervisory system called SuperFROG to coordinate vehicles in an automatic transport system. It also offers two types of vehicle with SuperFROG: Standard industrial vehicles called CFrog, and Heavy duty and people mover vehicles called Frog3. β cannot standardize its products because of the required customisation of the system. However, β standardized the core items of the systems: i.e. a versatile controller called the 'FROG-box' to handle all vehicle configurations, 'generic vehicle controller software' to control the vehicle, and a 'SuperFROG' transport controller for logistic control.

Problem definition

Software development at β is a complex process, which has been difficult to plan and control; therefore, β focused on the standardization of the software development activities.

The fundamental problem at β was customisation of project activities, which required a substantial work in software programming. β employs many highly educated professionals for the software development process. It has almost no formal structure since it relies entirely on professionals and their innovative outputs to fulfil the projects.

Innovation strategy at β is a KCSF. Similar to Human Relations Model (Handy, 1985), at β, culture is pivotal in its external and internal focus to human commitment, decentralization, differentiation, expansion, adaptation, competitive position of the overall system, maximization of output, consolidation continuity and maintenance of the socio-technical system.

Business strategy

β based its business strategy at five principles: social, legal, economic, politics and technology (SLEPT).

> *Social***:** West has been increasingly polarizing; the gap between rich and poor has been growing. The power of the rich has increased. Workforce Unions are losing their in the majority of companies, clearing the way for completely automatic systems.

> *Legal*: The Sept-11th bombing caused a drastic move to strict law enforcement worldwide. This resulted in reduced acceptance of individual rights. This may result in a reduced risk for product liability.

> *Economic*: The financial scandals and the low stock market influenced the market for β. Companies 'clean' their books and need to revalue their operations as their stocks are down. Shareholders critically monitor the value of companies and check the value of assets (equipment) in the books. This leads to easier approval of investment plans for the automation of the current operations.

> *Politics*: The 9/11 attack caused a shift in the government policy from 'well-being' to security. Therefore the people mover business has expected to decline as governments (the target group for people movers) changed their priority from the environment to security and control.

> *Technology*: Recent technology developments caused a drastic improvement for the acceptance of vehicle guidance. Many people are familiar with navigation systems and wireless communication. The lower price for these subsystems and computing power has reduced the price of AGVS to an increasingly acceptable level.

At β, the complexity of business processes is compatible to the Layered Process Model Systems (Robinson, 1999) with the main components of process (i.e., project scope, objectives and work breakdown structure), formal structure (i.e., task assignments, schedule, budget, quality plan, change control and risk management), informal structure (i.e., relationships, friendships,

subgroups and power blocks), interacting self (i.e., personal ability, skills and fit with the work), inner self (i.e., sense of identity and fit with the project), archetypal role (i.e., symbols, stories, myths and traditions). The introduction of a system to control the formal structure will therefore be rather costly. It will have to be integrated to the β informal structure and this has been built on the personal skills of the individual employees. β used the Market Attractiveness and Competitive Position (MACP) theory (Jobber, 2000; Porter, 1985, 2001; Smith, 1999) to build a business case for the application of information technology in its business processes. Therefore, β combined a marketing plan (Van der Werff, 2001) and with a marketing survey to evaluate the financial benefits. β used the SOSTAC framework (Smith, 1999) as a guideline for the implementation. The SOSTAC framework includes situation analysis, objectives, strategy, tactics, action and control.

Business processes

The main processes at β manufacturing are sales, projects, engineering, assembly, installation and services. In its restructuring efforts, β only changed the automation level at the management report and inventory control. It was neither able to change the business processes, nor was it able to change the organizational structure. β creates highly customized machines with high-tech solutions for the automation of production processes. β analysed the market requirements and the capabilities of β to find the e-business solution (e-marketing, e-procurement, etc) and the return on investment. It found out that the first step towards e-business was standardization of the β business processes.

β performed a situation analysis for β based on the MACP map (Jobber, 2001). Field research in the form of a structured questionnaire provided market information. The goal of the situation analysis was to determine the needs of the market and how β could perform at fulfilling these needs. Customers were not contacted directly because the awareness of strategic (internal) issues could damage the image of β. β provides a strategic product, so the customers' buying strategy is mostly 'partnership' (Kraljic, 1983). The business unit managers and project managers therefore have good relations with the customers decision-making unit (DMU) and know their demands.

Box 1 - β

β *capability analysis*

β operates in the 'tailor made' segment of AGV systems at global market and its focus is in the segments where AGVS are most demanded: Automotive, Food, Electronics and Transportation. The market needs are mapped to the company's capabilities in a *MACP* map (Jobber, 2001). The research questionnaire summarized all components of the product and business functions as capabilities of β. In its market analysis, β refers to the functional components of the FROG products as "capabilities". In this way, β allocates the functional needs to each customer group. β also refers to the business functions as "capabilities".

Box 2 - β

These business functions have been derived from the internal value chain model (Porter, 1985) with the primary processes in production & service, projects (engineering, vehicle control, application),

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development and support (technology development), operations (HRM and infrastructure) and supporting processes in inbound logistics, assembly & test, installation (outbound logistics), marketing & sales, and service.

Market Research; what are the market needs ?

The global AGVS market survey (Schultze, 2001) ranks β between the largest industrial AGVS vendors in the world holding a 10 % market share. β supplies an average price per AGVS of its competitors for differentiated systems, but β cannot (and will not) compete on mainstream pallet transporters. A growth-share matrix analysis showed how the differentiated products from each business unit could perform in the AGVS market. According to the theory of the MACP model (Jobber, 2001), β should invest in its stars (people mover and automotive), divest its dogs (cargo and entertainment) and harvest its cash cows (industrial applications). An Ansoff matrix (Ansoff, 1968) for β products is based on the history of the product; i.e. dates and numbers from the sales reports provided information on the market potential. The people mover products were 'repositioned' (Jobber, 2001) from group transport to personal- and public transport. This repositioning had more risk than the 're-launch' strategy of the automotive application, which is a modified industrial application.

Gap Analysis; How does it fit with what β does ?

The weights for the MACP criteria were based on the order portfolio and marketing strategy, because the formal weighting criteria (Jobber, 2001) did not apply to the β situation. In other words, the objective measures for market size and growth do not reflect the situation at β. For instance, the general automotive market was not growing and β had a low market share while the people mover market was growing fast with a 100% market share for β. But for β, automotive orders were growing quickly, and they had a much larger value than the people mover orders and it required fewer modifications (i.e., less risk). Based upon the current order portfolio and the order growth of β, the following weights are determined: Automotive has the highest ranking (weight 5) because it has the largest profit potential; People mover has a second highest ranking (weight 4) because of its future potential; Industrial (weight 3) has average ranking because it is 'normal competitive business'. Cargo has a low ranking (weight 2) because it has no growth but requires some support; Entertainment has the lowest ranking (weight 1) because it has no growth and no support.

Strategic options: As 'a dominant position in the AGV market' is stated in the mission of β, there are three ways to achieve market leadership (Heskett, 1994; Treacy, 1993).

Customer Satisfaction: Customer-focused differentiation (Eckles, 1990) is to attract key customers in the industrial market. This is part of the β marketing plan and its 'core values'.
Innovation and technological leadership: *This* is part of the marketing plan and 'core values' of β. β keeps a low profile in the media, but uses its key references and innovations to gain the trust of potential customers.

Effectiveness and efficiency: Although not in the marketing plan, effectiveness is required to; reduce price for larger volumes (Headly's law) as management anticipates, increase professionalism to enter the maturity phase of the company life cycle (Greiner, 1988), and support cooperative development within the alliance.

In the process of 'Open FROG' blueprint, the 'Proposed and Quoted ' process is the first step in the back office process modeling of β.

The "Propose and Quote" Model is:

Project Management: request for proposal→calculate→estimate request (development)→ software development: planning→software estimate→Project Management: calculate →proposal

When the customer accepts the proposal, the proposal is signed and it becomes a contract, after which the order will be carried out.

The "Propose and Quote" Process Model for Software development is:

Project Management: Contract→Control→Change Request→Software Development: Detailed Planning (task description)→Develop (implementation) → Test (test plan)→Feature→Integrate → Package (configuration)→Release→Project Management: Control→Installation

This process is a success factor in β management of documents, and monitoring of the process steps is essential in the quality management of β activities.

Project goals (ERP Objectives)

β mapped the MACP gaps to the IT objectives. With a total score of 100% for all β activities, the improvement of the software development process had a high priority (33.6 %) as well as cooperative (software) development (18.5 %) with the international partners. The highest scores were for the product development (i.e., 10.6 % on vehicle sensors) and process improvement (i.e., 10.6 % on system integration, project management and software development). Table 3 presents the results of a management team workshop in ERP implementation at inbound and outbound logistics. β organized a workshop with representatives from the various disciplines in service, marketing, operations and purchasing in order to evaluate the impact of the IT integration on the organization. The participants of the workshop discussed the main topics of: Promotion (advertising), Product (features), Processes (working procedures), Proaction (cooperation with the suppliers), People (training) and Potential (opportunities).

β mapped the result of the workshop to seven C's for the e-business application (Table 4). β management concluded a low expectancy of benefits in e-business. Finally, the project was confronted with no budget, no cooperation and support from the management.

Table 3: Summary of the workshop.

Topic	Items discussed	Pros	Cons	Perceived value
Promotion	Online ordering	24 hour sales	None- standard pricing policy	Low, sales contact required
	Online product specs	Serviceability	Accessible to competitors and entrants	Negative, copying must be prevented
Product	Online servicing	Quick customer assistance	Liable to sabotage	None (dial-in is supported)
	Online status monitoring	Distant tracking and tracing	Development cost	Low, in-factory logistics normally not public
Process	Online purchasing	Quick and cheap		None, already in place
	Online development Online project management	Work from home Quick and accurate project status	Accessible to competitors and entrants Expensive software package	Negative due to low web security None, project managers are doing fine
Pro-action	Information sharing	Easy cooperation with suppliers	Accessible to competitors and entrants	Negative, mail exchange works well enough
People	Online learning	Easy access	No employee trainings defined	None
Potential (cost reduction)	Inventory control	Accurate information	Software package cost	None, handled by EXACT
	Quality	Enforcement of procedures	Complexity of business process	Negative, works counterproductive and reduces flexibility

Table 4: Seven - C- Analysis for β.

Objective	Option	Potential	Why
Cost Reduction	Inventory	Low	Low value
	Ordering	Low	Low frequency
	Integration	High	Standardization
Customer Relation	Sales	Low	Personal contact required
	Service	Low	Customers reluctant to expose factory system to supplier
	Support	High	24 hour reachable, response guarantee
Company Culture	Integration	Medium	On-line development
Cooperation with Partners	Communication	High	Joint development
Creation of Value	Quality	Low	Personal contact, Focus strategy and Project Management suffice
Commitment Fulfilment	Integration	Medium	Low frequency
Charging and Billing	Electronic billing	Low	Low frequency Not wanted
Competitive Distinction	Differentiation	Low	Development must be in-house

IT infrastructure

β now uses General Public License (GPL) software for its controller, supervisory systems, development environment, and IT infrastructure. β deploys four systems of Exact Financials (Inventory control and accounting).

It runs in a Demilitarised Zone (DMZ-financial reporting, time accounting, inventory control), Super Office (a CRM groupware database) schedule sales and support sessions, stores Decision Making Unit (DMU), Linux, a Systems Development System (SDS-problem reporting + change request system-application development and intranet services), Internet access (component selection, on-line communication and procurement) in order to support its core processes. FNS concluded that that there was a need for a support system for project management and a software development process was established.

Implementation plan

In the course of recent Exact Financials implementation, project management took a critical role in the implementation process. In the post implementation period the β states; "*The level of training was low and the benefits from Exact "piece of tailor-designed ERP" implementation were inadequate.*" β established a detailed plan with steps; (a) defining processes, (b) evaluating packages, (c) implementation process, (d) test-run, and (e) open to the public.

COMPARATIVE ANALYSIS AND CONCLUSION

In a business case analysis for automation of the software development processes within β, the β identified a number of KCSFs required in IT implementation from the previous and on-going efforts on ERP acquisition within β. These KCSFs were management involvement, organizational fit, innovation strategy, understanding internal processes, convincing the staff of the overall benefits of IT integration to them and to the firm, progress reports and results report.

β had an embedded approach towards rationalizing the ERP application. The firm had already custom-designed an Exact financial package for the administration purposes. In their business case analysis, β searched for an optimal in-house or package system to support their core competency, which is software product development. β organized workshops at management and professional levels to investigate the needs and motivation for seamless integration of business processes. β finally concluded that development of own-custom-designed system incrementally would be the best support solution to its current business growth. This case was an interesting business case analysis within a high-tech firm with professional personnel.

In development of the custom-designed ERP *α*-net, we pictured the KCSFs at various stages of research as; clear problem definition, clear scope of implementation, clear implementation project plan, corporate culture or people resistance, level of IT skills/knowledge, training, management involvement, understanding client business processes, pilot test implementation,

integration with IT supplier, a thorough business case analysis, and acquiring and building in-house ERP implementation knowledge and skills.

α had a self-embedded approach in realizing a custom-designed ERP system to improve the integration of its business processes within client business processes. A stage-wise development and implementation of a custom-designed ERP system over several years boosted the firm potentials. α later implemented its new system with a potential client in partnership. The upgrade of its services in quality, efficiency and speed by partnership and successful implementation boosted the firm's reputation among new potential clients.

The firm expanded its services from accounting services to intermediate weekly and monthly accounting and consulting services to clients.

First of all, the implementation plan at β froze at implementation phase whereas the implementation at *α* provided the expected benefits to client and supplier.

The implementation plan for software development of automation for high tech manufacturing was a innovative initiative whereas accounting practice for a service provider had already been explored by other firms and ERP provider.

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[*] Chaffey (2002) defines EDI as follows: "The exchange, using digital media, of structured business information, particularly for sales transactions such as purchase orders and invoices between buyers and sellers".

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