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BPR-BASED INFORMATION SYSTEMS PLANNING FOR E-LOGISTICS: A CASE STUDY

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ABSTRACT

This paper presents a case study conducted in a semi-conductor manufacturing company concerning information systems planning in the context of reengineering business models for e-logistics. A framework based on business process reengineering (BPR) is described. To enhance BPR efforts, the benchmarking technique is introduced as an analysis tool for redesigning business models. The framework emphasizes the reengineering of business models for e-logistics through value chain mapping and analysis. It also takes into account the unique possibilities of legacy information systems architectures, thus further advancing the value of a company's past investment in information technology.

Keyword: Electronic commerce, logistics, business process reengineering, information systems.

1. INTRODUCTION

The buyers' market and global competition require manufacturing companies to manage multiple information and material flows cross-organizations simultaneously in order to source, manufacture, and deliver their products with better quality, shorter lead time, and lower costs. This change has precipitated a radical shift in the thinking about the architecture of production, the importance of traditional supply chain relationships, and most importantly, the role of logistics. As a distinct function within an organization, logistics' primary role has been the movement of goods and materials from point to point along the production supply chain. Information about customer requirements used to be captured in aggregate long-range forecasts

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that drive the production cycle. However, forecast-based production systems are no longer adequate to meet the rapidly changing demands of the marketplace. Companies must increasingly organize their operations around real-time information about shifting customer needs and about the availability of their productive capacity. They require not only up-to-date and immediate information about the location and disposition of all productive assets, but also information linking the location of the asset with available transportation opportunities. Under such conditions, logistics is becoming a primary enabler of real-time response to customer needs [10] [33].

Recent advances in the field of computer networks and telecommunications have increased the significance of electronic commerce. Managers and academic researchers are predicting the huge potential of the latest networking technologies in conducting logistics-related functions. It has been widely argued that marketing through the Internet and World Wide Web provides transaction specific efficiencies to all the stakeholders [19]. The customers get benefits due to lowering of search cost, while the manufacturers get the benefit of the economy of production, because they can attract more business from the customers by providing their products and services at a lower cost. Besides, by capturing customer specific needs, the Internet and World Wide Web can open further opportunities for the customization of products and services. Such an emerging trend dictates the so-called e-logistics, a group of strategically aligned companies focused on specific market opportunities through electronic commerce. The advantage of e-logistics derives from a company's ability to explore quickly not only its internal resources, but also the collective resources of the entire extended network of suppliers, vendors, buyers, and customers. The emergence of e-logistics presents challenges as well as opportunities. Information must now traverse both the organizational boundaries and great distances that separate and span the entire enterprise. At the same time, the expanded information flows provide an unprecedented opportunity to build new logistical systems and knowledge-based tools. The power of e-logistics lies in its capacity for bringing together previously unlinked information across the entire production supply chain and, in turn, for building more effective tools to manage complex flows of information and materials [16].

While the use of the Internet for logistics applications has spawned new business models and radically transformed existing ones, it is important for companies to carefully plan for and architect their information systems. The traditional way of improving programs like restructuring, down sizing, process rationalization, automation, etc., have not been able to yield the necessary improvements of what the companies need for boosting their system performances. The high investment in information technology has produced unsatisfactory results largely because the companies tend to use the technology to mechanize the old and conventional ways of doing business. They leave the existing business processes intact, and use modern computers simply to speed them up, where fundamental performance deficiencies may have not been addressed. In addition, many of the job designs, work flows and control mechanisms came in a different competitive environment and before the advent of the computer. They are being used towards efficiency and control of the new decade of innovation and speed, service and quality. It is now the time to deter old paths of outdated processes and begin to reengineer the supply chain structures by radically redesigning the business processes with respect to the power of modern information technology. This will help achieve dramatic improvement in their performance as well as a wider picture to encompass all trading partners and in some cases even end consumers [36].

Towards this end, this paper discusses information systems planning in the context of reengineering business models for e-logistics. A case study in a semiconductor manufacturing company is reported. A framework based on business process reengineering (BPR) is described. To enhance BPR efforts, the benchmarking technique is introduced as an analysis tool for redesigning business models. Moreover, it takes into account the unique possibilities of legacy information systems architectures, thus further advancing the value of a company’s past investment in information technology.

2. INFORMATION SYSTEMS PLANNING

In the context of logistics management, information systems are considered in their computerized form, and taken as a set of hardware, software, people and information exchange procedures, which are required to process data and produce information that is acted within the supply chain. Liebenau and Blackhouse [24] point out that improving information systems does not necessarily mean improving the information technology (IT). Conversely, improvement in IT does not always mean an improvement in the information system. However, substantial amounts of budget continue to be devoted to the purchase of IT, in the anticipation that in some way the deployment of new technology will offer itself as a panacea. Clearly, the development of information systems goes beyond the adoption of IT, and requires an account of those factors that complement IT for strategic, tactical or operational gain, with the implications of such being as far reaching as benefiting the supply chain.

Adequate IT infrastructure reassessment and development have been considered as a vital factor in successful information systems planning. Building a responsive IT infrastructure is highly dependent on an appropriate determination of business process information needs, and this, in turn, is determined by the dynamics embedded in a business process. This necessitates a synchronized planning for developing both business processes and IT infrastructure [11]. An effective IT infrastructure development process follows a top-down approach, beginning with e-logistics strategy and information systems strategy and passing through designs of data, systems, and computer architecture [26]. Linkages between the IT infrastructure components, as well as descriptions of their contexts of interaction, are important for ensuring integrity and consistency among the IT infrastructure components [31].

In addition, investing in a new IT infrastructure may take two forms: insourcing (internal sourcing) and outsourcing (external sourcing). A sourcing decision should make a tradeoff between internal and external IT infrastructure development. Although cost is a decision factor in this process, other issues must also be considered. Overall, sourcing decisions must be driven by both IT infrastructure and e-logistics strategies. Organizations must not consider outsourcing as a quick fix for their weak IT components management [9]. However, a multisourcing strategy seems to be effective when organizations insource their strategic IT components and assign the sourcing of uncritical components to outsiders [23].

Moreover, information systems integration for e-logistics can be viewed as the extent to which various information systems are formally linked for the purpose of sharing complete, consistent, accurate, and timely information among business processes [2]. Data integration and communication networking are the most important enablers for information systems integration. Within an integrated organization, a full set of integrated information systems use a common IT infrastructure, which enables data sharing and communications to support all business processes. A recent survey of critical issues in information systems management shows that companies are still dominated by function-based software development approaches, despite their accumulating experiences in the advancing techniques of supply chain management [25]. This indicates a gap between the way business processes are being redesigned and the approaches used to develop supporting information systems. Nevertheless, advanced technologies, such as the Intranet, Internet, some ERP, and Workflow computing, are useful in connecting functionally organized systems and data across function boundaries and thus provide opportunities to build process-oriented applications.

Furthermore, due to the often mismatch between the standards of new technological systems needed by the newly redesigned processes and the legacy architecture of current systems, current information-systems technology should be reengineered in order for cross-functional applications to achieve alignment with the newly redesigned cross-functional business processes [25]. Reengineering legacy information systems is aimed at using corporate resources in a most economic way, i.e., re-using application knowledge to a maximum extent.

3. A ROADMAP BASED ON BPR

Business process reengineering (BPR) was first introduced by Hammer [13] and Davenport and Short [7]. The essence of BPR is not about incremental improvements but about major step level improvements. The reengineering methodology is generally based on two models. The "holistic wheel" is based on "business system diamond" and starts with the customer at the center of it [14]. There are two important ideas with respect to the customer: (1) the customer must become the center of everything the business does, and (2) customers drive the entire business system. The second implementation model is the "framework at a glance" developed by Texas Instruments [18] for Kodak practitioners to use in conjunction with the BPR team. The methodology provides four engineering phases: project initiation, process understanding, new process design, and business transition.

There are no hard and fast rules to applying BPR since every company has its own unique situations [12]. Most BPR initiatives, however, are focused on organizational structures and the reengineering of activities and processes. In the context of e-logistics, reengineering is aimed at aligning the planning of information systems with business processes, that is, to focus on e-logistics business models. Figure 1 presents such a reengineering roadmap, where there are two areas and three bodies could assist in, and in turn benefit from, the reengineering effort. The first area refers to the external area involving the interaction between customers and the company. The second one refers to the internal area consisting of company's operations and its backend applications. Three parties are involved: management levels, reengineering team, and the user, including both customers and the process owners. The details of the roadmap will be discussed below. Along the line, some tools are highlighted for the implementation. By the end of the reengineering practice, the organization can choose to do the system implementation internally if they have the capabilities. If not, outsourcing to vendors will be more practical for most organizations. Nevertheless, the core part, reengineering of business models, is always "insourced".

Figure 1 A BPR-based roadmap of information systems planning for e-logistics

3.1 Trigger BPR in the Organization

When the management identifies the need and determines to move towards e-logistics, the reengineering initiative is set up. Usually, the management meeting is called for to set the vision for improvement and lay the objectives for the reengineering effort. Another consideration to be brought up during the management meeting would be the plan for the employees to accept BPR in the organization.

3.2 Organize for BPR

A reengineering team will be formed with one of the managers as the leader. This leader is a bridge and facilitator of the flow of information between the management and the team. The team should be multi-disciplinary because process reengineering may have significant effects across organizational boundaries and may exert some impacts on the external suppliers and customers. For example, departmental managers can be the team members. As the managers can interact with their departmental staffs easily, collection of data can be accomplished in a hitch. Upon the first meeting, the team should determine objectives and project milestones. This scheduling will assist the company to organize and move on with other business plans without hindrance from previous projects.

3.3 Understand Current Processes

There are three tasks involved in this stage, namely data collection, process mapping and process analysis.

(1) Data Collection. Collection of raw data is important to understand the business processes and narrow down to the problem. Several tools are useful, as described below.

Interview. Successful interviews should consider these issues: (i) A set of questions pertain to business processes, logistics, problems encountered and suggestion for improvement; (ii) The questionnaires include some open-ended questions for descriptive answers and close-ended questions for the normal type; (iii) All departments are asked using a common set of questions to obtain unbiased findings; (iv) The findings are compiled immediately; and (v) A report is generated based on the findings and validated by the interviewee.

Role-playing. As a terminology for watching the daily operations of the user, this method is used for both verification of process description as well as the understanding of the processes. Some people might tell a different story from what they did when asked about their job portfolio, and therefore this technique is used mostly in conjunction with either interviews or surveys.

Request from management. This is a faster way of obtaining the current business processes of the company. These processes may be the work of previous project done by others and therefore the validation must be carried out before use. Nevertheless, it gives the team a pictorial view fast and an alternative of process mapping by just updating the processes provided by the management.

(2) Process Mapping. Process mapping is aimed at obtaining a descriptive view of the organization's core processes, from which one can understand how inputs to be transformed to outputs throughout the organization. It is important to control the mapping at the right level of details as long as the problem can be identified. During this mapping, the team defines external connections and gives a high level definition of the core business process together with key supporting processes [20]. After the processes have been mapped out, they must be verified and validated by all users before the analysis.

In addition, organizations should adopt an integrated strategy to align the reengineering of business processes with the planning of their corresponding information systems. To provide useful information for process mapping, the "process perspective" encompasses several dimensions, including: (i) The functional perspective represents what process elements (activities) are being performed; (ii) The behavioral perspective represents when activities are performed as well as aspects of how they are performed through feedback loops, iterations, decision-making conditions, entry and exit criteria, and so on; (iii) The organizational perspective represents where and by whom activities are performed, the physical communication mechanisms used to transfer entities, and the physical media and locations used to store entities; and (iv) The informational perspective represents the informational entities (data) produced or manipulated by a process and their interrelationships. A number of process and information modeling techniques can be applied for this purpose, such as flowcharting [32], IDEF techniques (IDEF0, IDEF3, and IDEF1x) [27], Petri nets [30], simulation [8], knowledge-based techniques [15], role activity diagramming [17], data flow diagramming [21], entity-relationship diagramming [37], state-transition diagramming, and unified modeling language [3].

(3) Process Analysis. The purpose of process analysis is to seek possible improvements. A business process has its structure, inputs, outputs, customers and owners, and is built up by integrating fragmented functions that contribute to its operations and internal and external flows. IT can reshape business processes by facilitating the flow of information between globally distributed processes and ensuring that they are instantly and consistently available across the business. As the goal of BPR is to eliminate or minimize waste, the improvement should target a minimum amount of unnecessary processes and information redundancy, as well as inefficient operations. For such analyses, several tools for the identification of problems are important as described below.

Value-added analysis. The basic premise of conducting a business rests on the concept of value chain of the firm [28]. A value chain consists of five core activities: inbound logistics, operations, outbound logistics, marketing and sales, and services, together with four supporting activities: the firm infrastructure, human resources management, technology development, and procurement. Rayport and Sviokla [29] extend it to a virtual value chain, comprising gathering, organizing, selecting, synthesizing, and distributing of information. Bhatt and Emdad [2] point out the success of electronic commerce depends on the way the physical value chain and the virtual value chain activities are matched and integrated.

Value-added analysis starts from value chain mapping of those processes producing the expected outputs from pre-determined inputs. All existing processes are then compared with the essential value chain (both physical and virtual). Those redundant and irrelevant activities are deemed as non valued-added. These value-added and non-value-added activities thus provide hints for improvement. A pragmatic approach to conducting value-added analysis is to construct a hierarchy of accountability and map sub-accountabilities to activities [35].

Voice of customers. Johansson et al. [20] suggest that customers' feedback could be a source for identifying problems. The customers have been doing business with the company and would be able to provide some suggestions to the company to streamline the operations for their own good. Here the "customers" refer to both external and internal customers. Those users who involve in processes daily have their own perceptions of improving the processes such that their efficiency can be maximized.

Benchmarking. Benchmarking is an effective tool for driving continuous improvement programs by the provision of an external view and identification of best practice to strengthen areas with potential for improvement [6]. Primarily, benchmarking techniques identify efficient and productive business processes that can be used as a target for improvement of inefficient processes [34]. There are five major phases in the benchmarking process, which are planning, analysis, integration, action, and maturity [4][5].

In benchmarking, the companies selected for comparison, known as the benchmarking partners, must be industry leaders or being recognized as having "best in class" practices. In addition, the usage of benchmarking to identify problems is encouraged only as a last resort. The identification of benchmarking partners prior to the analysis could be an obstacle for many as the benchmarking partners might not be willing to share their success recipe. Tremendous efforts may be required in order to obtain the relevant documents and materials from the selected partners. Should the benchmarking partner be of another industry, the benchmarked processes have to be correlated to its own industry for comparison and the team must make sure the correlations are correct.

3.4 Redesign

The objective of this phase is to come up with a new business model that will eliminate all the problems identified from the analysis of processes. Three steps are involved: requirement analysis, conceptual design, and design evaluation, as depicted below.

(1) Requirement Analysis. This task not only provides the team what the new business model looks like but also layouts a scale for performance measurement. Accordingly, requirements for information systems are derived. These requirements should be discussed during the team meeting and form the main bout of the identified problems. The criteria include not only best practices used in term of technology or operational processes, but also the considerations or constraints given by the management or company's limitations.

(2) Conceptual Design. This step is aimed to propose solutions to a new business model and subsequently to conduct information systems analysis. In order to cure the identified ailments, process improvement ideas are generated based on such considerations as eliminating non-value-added steps, minimizing the time of certain steps, simplifying and combining some processes, selecting alternative operational methods, and wherever possible changing a serial process into a parallel process to avoid delay. To coincide with the new business model, redesign efforts should be devoted towards IT infrastructure, information systems integration, and the legacy architecture of current systems. "What-if analysis" is a common tool for examining design alternative. Benchmarking analysis also helps the alignment of legacy information systems with the IT infrastructure of the benchmarking partner.

(3) Design Evaluation. The objective of this phase is to appraise BPR efforts and select the best proposal out of many design alternatives. For this purpose, simulation can be used as an analysis tool as well as a visualization tool to support what-if analysis of possible solutions. It can also be used as an experimental tool whereby all possible business models can be compared and verified according to the objectives set by the management. Another important issue is performance measurement. It refers to the measurement of the tangible and intangible benefits and costs involved in both the implementation and operational phases. This method is used in conjunction with simulation and often helps in making decision of alternative selection subjective to given budget.

3.5 System Suitability

As shown in Figure 1, this task is throughout the redesigning phase. IT and information systems form the backbone for the entire business model and therefore system analysis is considered essential to implement reengineering efforts. The understanding of current systems is required in order to conceptualize the current business model. Upon the determination of the reengineered processes, it is recommended to conduct a system analysis to check whether the current systems can accommodate the reengineering efforts. Such questions should be answered as if revamping existing IT infrastructure or integrating legacy systems in the organization. A revamped system would be costly and it may demand a total shut down of operations for a period and thus it will only be encouraged for new start-up companies. The companies with large investment in legacy systems would be advised for system integration because it is cheaper and involves less training of employees. Moreover, the company should be able to maintain these information systems for its business operations.

3.6 Implementation

After the business processes and system architecture have been reengineered, outsourcing the implementation of the information systems is recommended. The outsourcing strategy not only capitalizes the core competency but also allows the organization to channel all its energy to the recipients of e-logistics.

4. CASE STUDY

4.1 Company Profile

SSM is a wafer fabrication company in Singapore. It is a joint venture formed by a leading electronics company (ABC) in Europe with a Taiwan semiconductor manufacturing company (TSM). SSM supplies a large volume of strategic and customized integrated circuits to the global market for a wide range of applications.

To facilitate global supply chain collaboration with ABC and TSM, the SSM management puts up an initiative for e-logistics, called Virtual Fab. The goal is to achieve better planning, sourcing, making and delivery with its business partners. Upon the completion of this project, SSM envisions a total internal Enterprise Applications Integration (EAI), whereby all databases are interlinked. The project idea is taken from its sister manufacturing plant in Netherlands, SMS, which has successfully implemented e-logistics. As such, the SMS e-logistics model is used as a benchmark for SSM Virtual Fab project.

4.2 Organize for BPR

A team is formed to re-look into the company's operations and reengineer its processes for improvement. The team is made up of managerial positions of different departments with the Customer Service Department Manager and the Logistics Department Manager as team leader and co-leader, respectively. The organization's high level vision and objectives are interpreted and project milestones are established.

4.3 Understand Current Processes

To obtain a clear understanding of current processes, a set of interview questionnaires are formulated and then surveys are conducted in all departments. With support from the managers, all departmental employees have achieved consensus on the reengineering effort. Interviews with process owners are done successfully with their cooperation.

Based on the survey results, existing processes are mapped out to show the operational processes of the organization and the interactions among them. The flowchart technique is employed in such process mapping. Finally, the process flows are verified and validated by the process owners. Six core processes are identified and mapped out as shown in Figure 2(a), including prototyping, order processing/scheduling, production, wafer acceptance test (WAT/PCM), electronic sorting (E-Sort), and shipping/invoicing/collection. The workflow of the prototyping process is elaborated in Figure 2(b). All other functional processes can be described with more details in a similar way.

Figure 2 Mapping of SSM business processes

In order to understand the workflow of the whole organization, the capability, interactions and deliverables of each legacy system are studied. Based on results of process mapping and users' information, four main database systems are identified important for external interactions with customers and suppliers. They are Manufacturing Execution System (MES) for shop-floor operations, Engineering Data Analysis (EDA) for process analysis, Product Database (PDB) for product specifications and technical information, and SAP for production planning, sales and distribution management and finance investment. These systems have been developed independently from one another and served daily operations at different departments. The transfer of information among these databases is done manually, i.e., through flat files. With the assistance of the IT and Automation Department, these backend applications of SSM are depicted as flowcharts. Due to space limitation, only flowcharts of the SAP and APS are given in Figure 3, where interactions among different systems are highlighted as well as manual data input/output.

Figure 3 SSM backend application systems

The above operational processes are then examined via value chain mapping to determine which step or task adds value and which not. In the context of information systems, the focus of value-added analysis lies in the examination of information flows among business processes. Figure 4 shows value chain mapping in terms of enterprise integration. Both customers' and suppliers' feedbacks also contribute to the identification of the problems. Through this analysis, possible areas for improvement are identified as shown in Table 1.

Figure 4 Value chain mapping for SSM information integration

Table 1 Problems associated with current SSM processes

4.4 Redesign

Before proposing any improvement of current processes, the team tackles the identified problems individually for best solutions. All proposed solutions must align with the organization’s strategic plan set by the management. Then the team lists down, groups and summarizes all points attributing to the proposed solutions. Some considerations and constraints are also brought into the listing. All these serve as guidelines during the redesign phase, including: (a) Application must be easy to expand with market needs; (b) Business must be on-going during the implementation; (c) Promote Web-based applications as most customers are familiar and less training required; (d) Interaction platform must be user-friendly; (e) E-environment should be encouraged for error-free working environment; and (f) Speedy and low cost implementation should be recommended. These guidelines not only provide the team with a pictorial view of the new business model but also a scale for performance measurement. The reengineered processes should conform to all these guidelines for a total success.

In designing new business model, the team can either use ‘what if’ analysis to design the business processes in a top-down fashion or switch to benchmarking analysis to “customize” a best-practice model. In this project, benchmarking is adopted for SSM Virtual Fab. SMS GmbH, being SSM’s headquarter in Germany, has the same vision and strategic planning as SSM. Figure 5 shows the value chain of SMS GmbH. SMS GmbH has agreed in supporting SSM to implement e-logistics by sharing required documents with SSM. To do so, a CD-ROM of SMS GmbH online functionality is given to SSM to assist in fast implementation. Since both SMS GmbH and SSM are in the same industry sector, the adaptation of SMS business flows to SSM’s is technically feasible, pending upon certain variations and slight fine-tuning. In addition, SMS GmbH has modeled itself to be compatible with TSM, which is presently the top leader in this industry. For these reasons, the SMS GmbH business model is employed as a benchmarking partner. To begin with, the SMS GmbH business model is analyzed to confirm its suitability by conducting simulation tests. After satisfactory results are obtained, the team decides to work on system analysis based on the benchmarked processes. Thus, the new business model is proposed for SSM e-logistics, as shown in Figure 6.

Figure 5 SMS GmbH value chain mapping

Figure 6 SSM new business model for e-logistics

4.5 System Analysis and Design

To implement the new business model, the e-logistics initiative is put up (i.e., Virtual Fab). The focus is the integration of legacy information systems at SSM. The main task of system integration is to enable the interface between the Virtual Fab system and the company backend applications. Figure 7 shows the strategy for SSM enterprise application integration (EAI) by introducing a data mart as the interface to the Virtual Fab server.

First, the functionality of the SMS online system (SMS Virtual Fab) needs to be checked. This is done by setting up a server as the prototype of the SMS online system. The architecture of the online system is then analyzed and documented, as shown in Figure 8. It is recognized that SSM Virtual Fab system should also work as a mini database for customers to check product status so as to enhance the efficiency of the web-based platform. With reference to the benchmarking system, the system architecture of the SSM/SMS model and its functionality are designed and documented as Data Flow Diagrams (DFD) and Entity Relationship (ER) diagrams. DFD are employed to show the possible patterns of information transfer between business partners and company backend applications in a top-down fashion. Figures 9 and 10 show the system level DFD of the SSM Virtual Fab system, where major system functional processes are described as well as the data exchange among them. Each of these functional processes can be “exploded” to more details by furthering developing lower-level DFDs. ER diagrams, on the other hand, are employed in database design to model the relationships among entities. An ER diagram can be used to reveal how the database is to be installed and serves as a reference once a database is in use. In most cases, boxes are used in ER diagrams to indicate data items or entities, and lines to show relationships between data items and entities. The strength of ER modeling is the conversion of one-to-one and many-to-many relationships to one-to-many relationships. Due to space limitation, only the ER model for the prototyping process is given in Figure 11.

Figure 7 Strategy for SSM enterprise application integration

Figure 8 Virtual Fab system architecture

Figure 9 SSM Virtual Fab: Context diagram

Figure 10 SSM Virtual Fab: Data flow diagram

Figure 11 SSM Virtual Fab: ER diagram and data description for the prototyping process

4.6 Implementation

The team adopts a strategy of outsourcing the Virtual Fab system architecture to the vendor. As such, requests-for-quotation are drafted. Upon the system completion by the vendor, all users are invited for a User Acceptance Test (UAT) and asked for their feedback. After improvement, Virtual Fab goes 'live'. All these are carried out with the copy-smart strategy from the SMS Virtual Fab system. Some snapshots of SSM Virtual Fab are shown in Figure 12.

Figure 12 SSM Virtual Fab snapshots

5. CONCLUDING REMARKS

The SSM Virtual Fab project has successfully demonstrated the potential and the feasibility of applying BPR to plan legacy information systems for e-logistics. BPR not only enables a systematic approach to e-logistics implementation, but also helps the organization understand the core competency, leverage its businesses, and align the integration of information systems with the organizational objectives. The foremost of the BPR-based framework is to set business visions and objectives. This stage is extremely importance as it is a critical factor in BPR execution. The objectives also set the path of the reengineering effort. Based on the mapping of organization's current operational processes, the core competency and problems are then identified by value-added analysis. The problems are tackled with the realization of innovative redesigns. Evaluation of different alternatives is carried out to determine economical and efficient operational processes. Before implementation, reviewing the suitability of legacy systems is beneficial.

The general framework of BPR has been exercised by SSM, including such steps as defining the organization's objectives, understanding the company’s processes, redesigning the processes with IT being incorporated, and modeling and implementing the proposed solutions. Nevertheless, minor inconsistency has been found in SSM reengineering practice. Hammer and Champy [14] point out the team should be made of various areas of responsibilities. What SSM has done is to gather all departmental managers with Customer Service and Logistics as leader and co-leader, respectively. The rationale lies in that these two are in close relationship with external parties and can gear the reengineering effort toward the interest of customers and thus improve the service level. They also facilitate supply chain factors to be highlighted in reengineering. In addition, the SSM team leaves out the issue of organization’s value and culture as pointed out by Johansson et al. [20]. In SSM, the issue of employees' acceptance and willingness to change has been solved by the management at early beginning. Moreover, during the visualization and mapping phase, the SSM team has studied the existing backend systems in addition to the current processes. This is a must for information systems planning. Furthermore, SSM has turned to benchmarking analysis in the BPR redesign phase. Although we have reconfirmed the BPR theory summarized by Klein and Manganelli [22], the combination of BPR with benchmarking has not been widely mentioned and practiced.

BPR and benchmarking can produce similar deliverables such as identification of core processes and improvement or streamline of processes in accordance with high-level strategic planning. Both of them encompass obtaining data and information, mapping current processes, and eventually analyzing the problems within current processes. Nevertheless they belong to different camps and manifest some differences. First, the precedent of steps is different. The identification of the process to be reengineered is the onset of benchmarking. On the other hand, this identification of target is done upon mapping of current processes in BPR. Second, the BPR effort concentrates more on designing components. The success of redesign depends on the creativity and experience of the team. Benchmarking, on the other hand, is more focused on the "copying" technique. The forte manifests itself through modifying/tailoring the best practice to suit one's requirements. In short, the emphasis of BPR is the feasibility of the reengineered processes, whereas the major issue of benchmarking is to correlate the benchmarked processes to one's own use.

Reengineering suggests itself as an important tool for developing business models in information systems planning. SSM has demonstrated that benchmarking and BPR can complement each other to improve the reengineering effort. In the Virtual Fab project, BPR sets the ground and leads to benchmarking during the redesign phase. Likewise, benchmarking can lay the path for BPR. After analysis of the performance gap and implementation in the company, BPR can be introduced to measure the performance of new business processes.

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BIOGRAPHICAL NOTES

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List of Figures and Tables

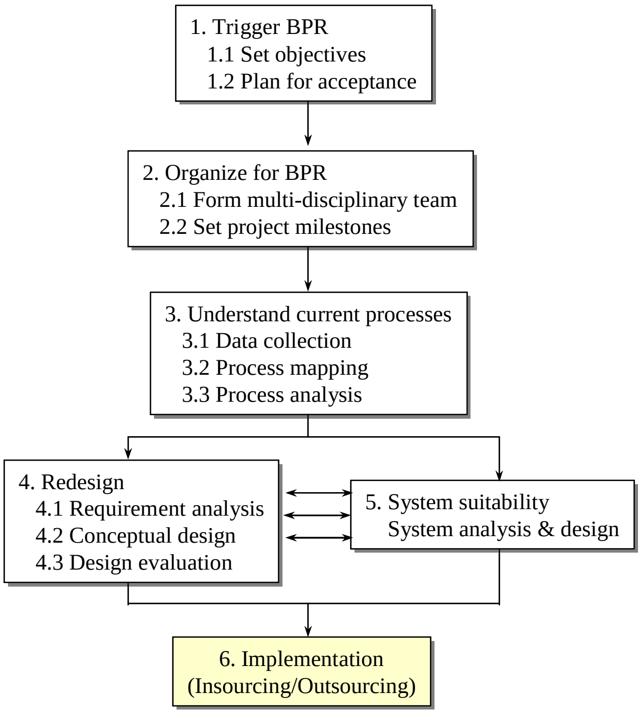
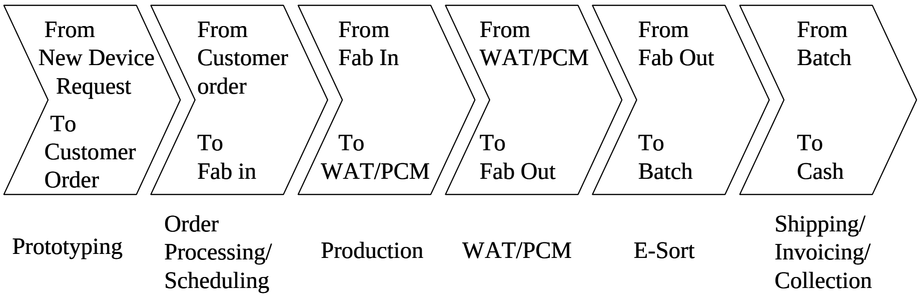
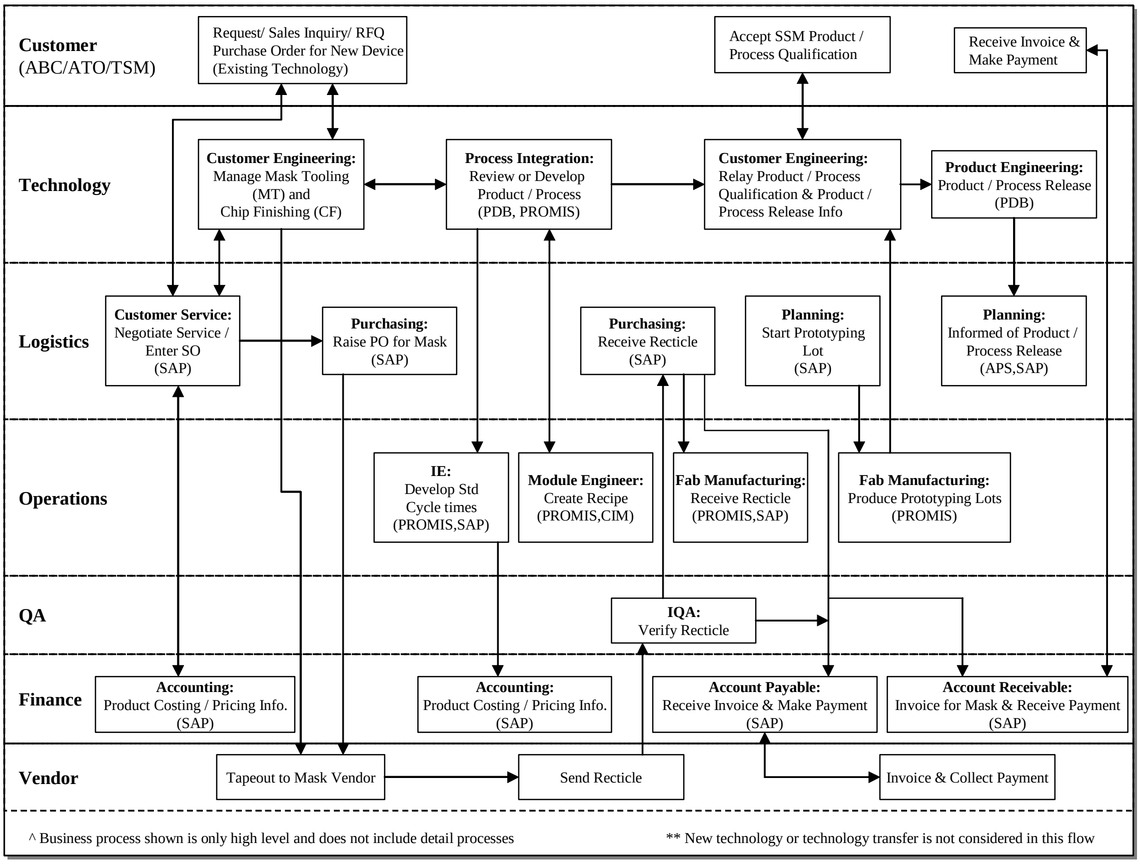


Figure 1 A BPR-based roadmap of information systems planning for e-logistics

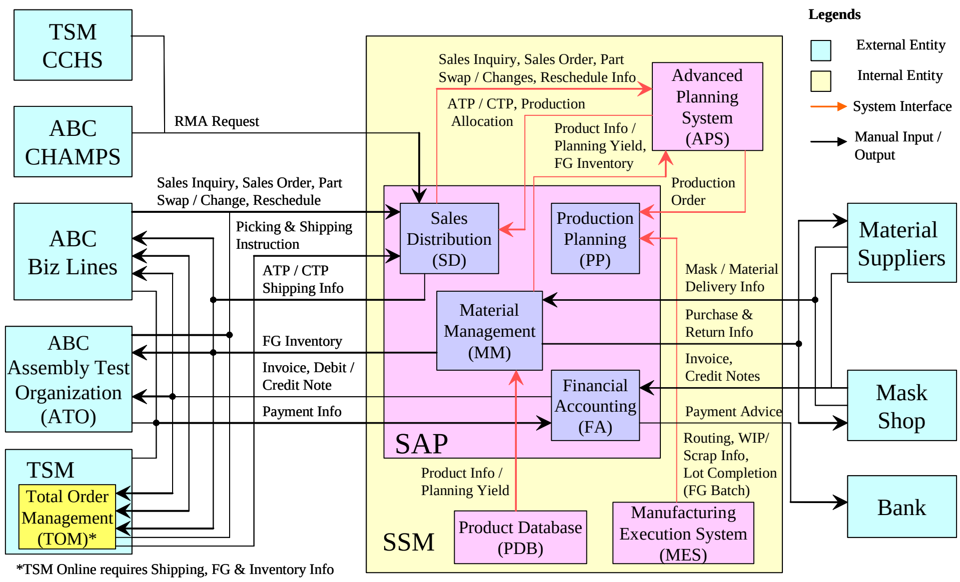


(a) High-level SSM business process blocks

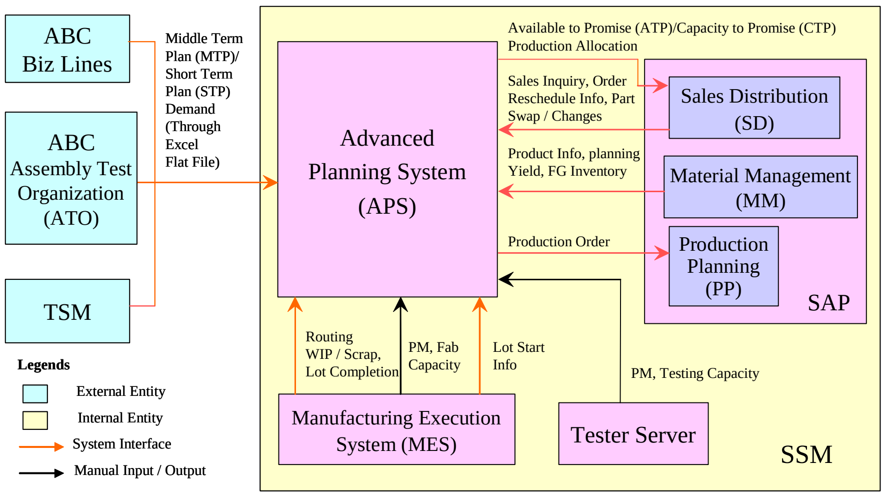


(b) Flowchart of the prototyping process (From new device request to customer order)

Figure 2 Mapping of SSM business processes

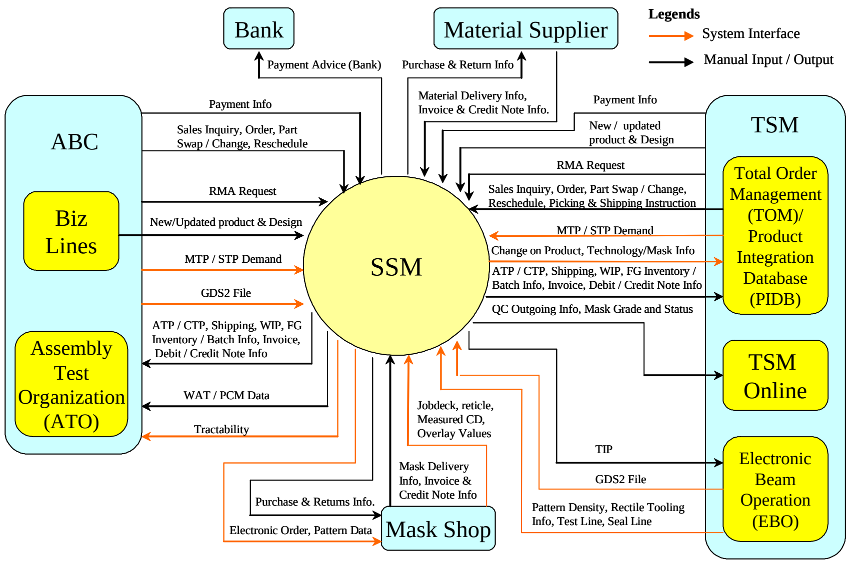


(a) SAP system interfaces

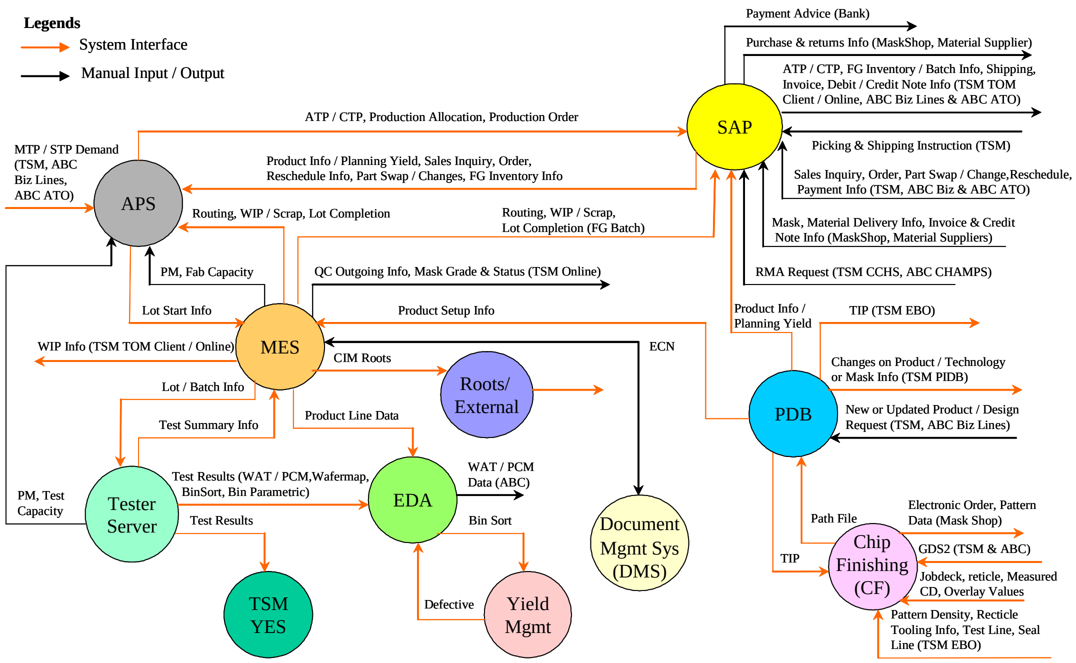


(b) APS system interfaces

Figure 3 SSM backend application systems



(a) External information integration



(b) Internal information integration

Figure 4 Value chain mapping for SSM information integration

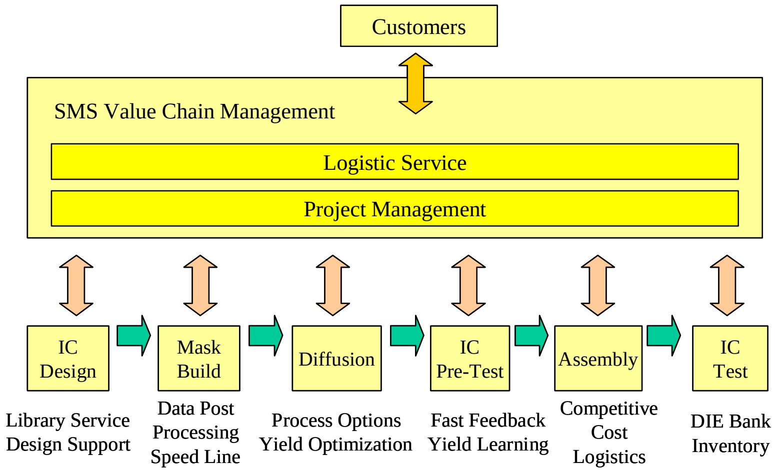


Figure 5 SMS GmbH value chain mapping

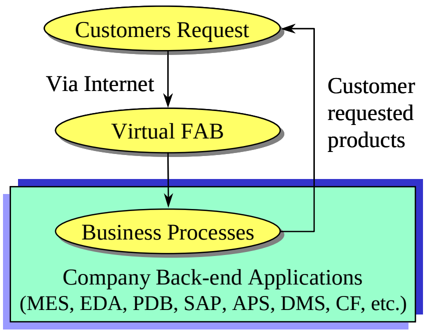


Figure 6 SSM new business model for e-logistics

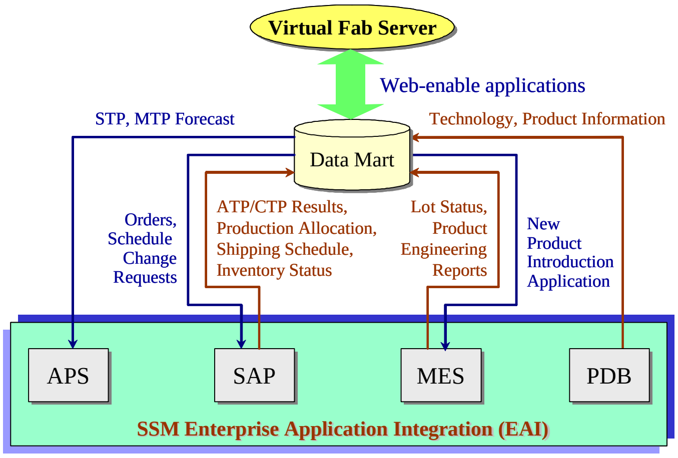


Figure 7 Strategy for SSM enterprise application integration

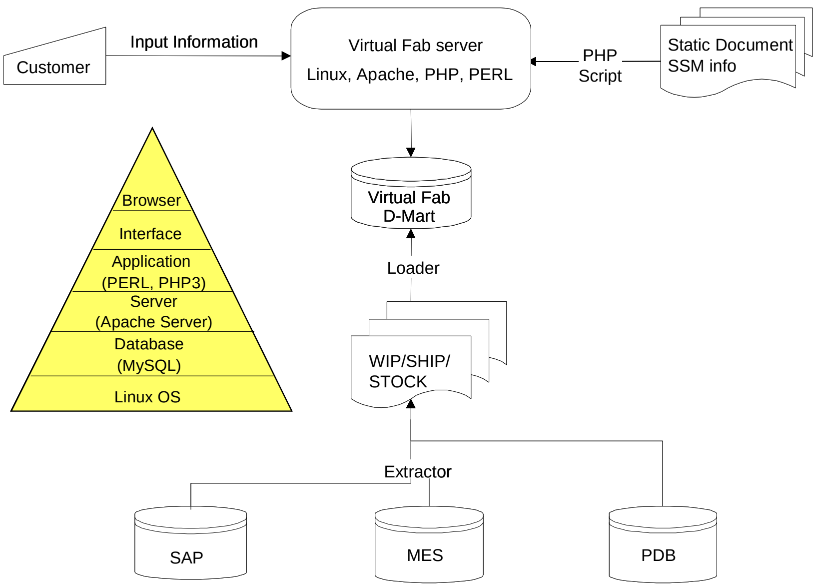


Figure 8 Virtual Fab system architecture

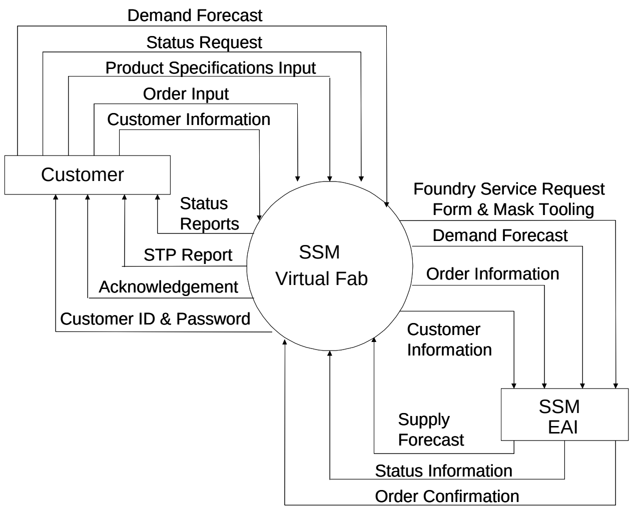


Figure 9 SSM Virtual Fab: Context diagram

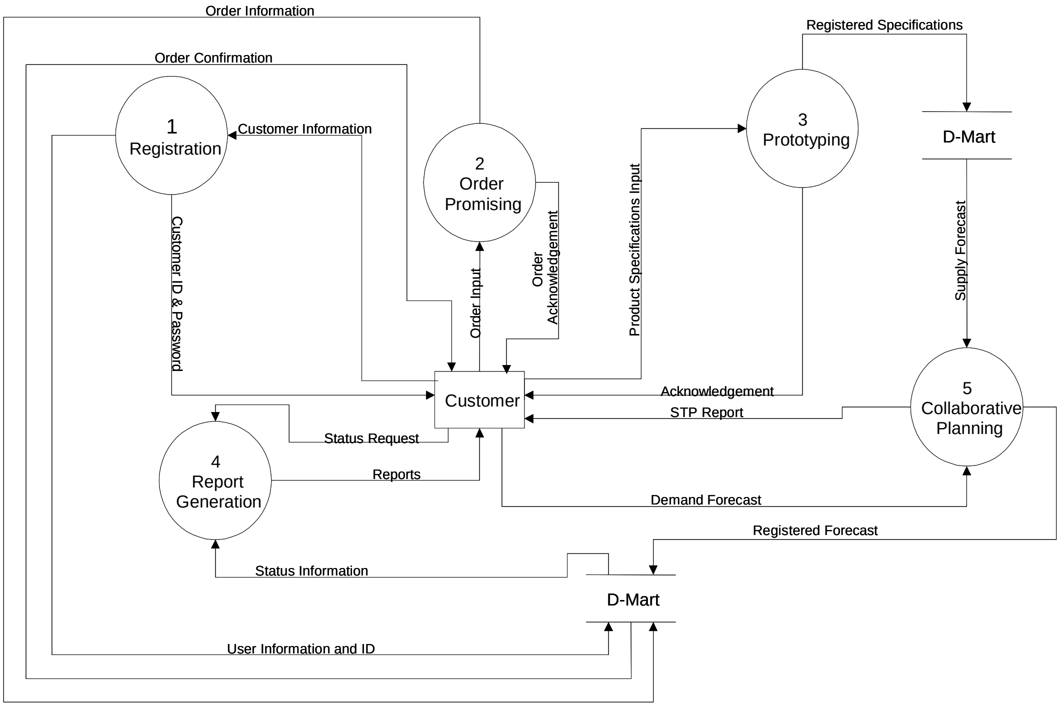


Figure 10 SSM Virtual Fab: Data flow diagram

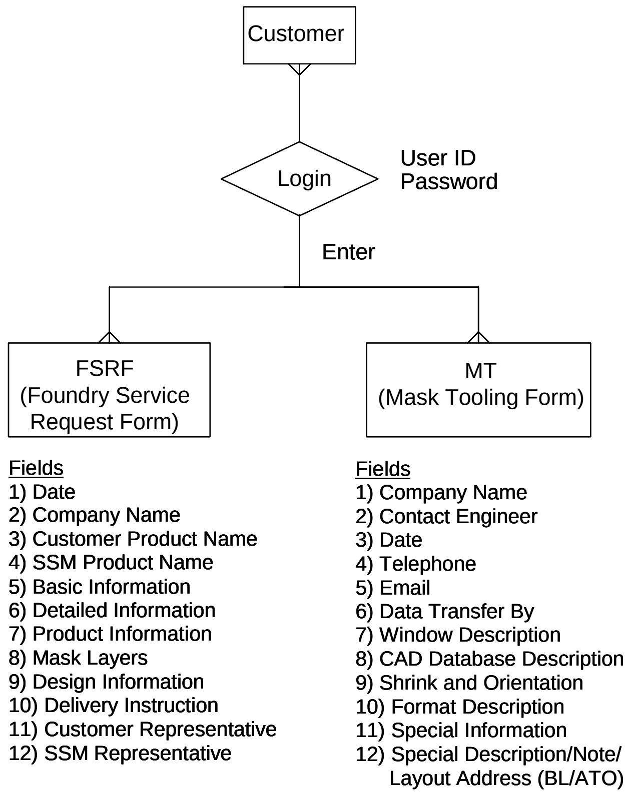
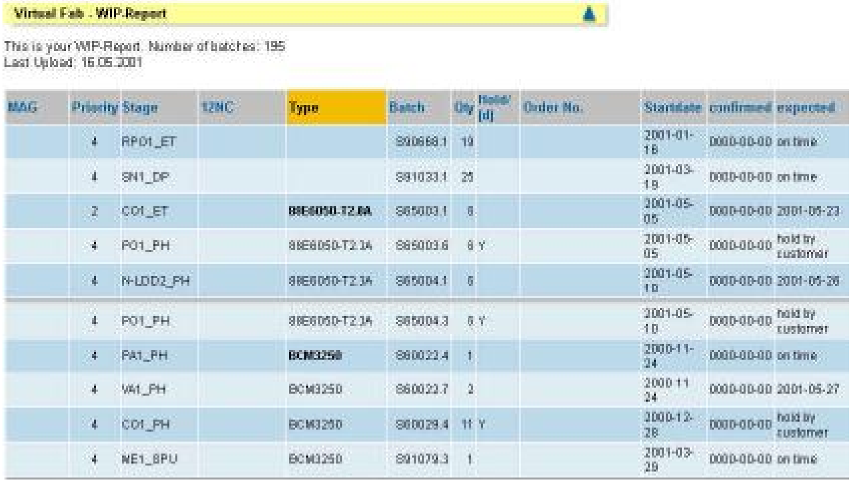


Figure 11 SSM Virtual Fab: ER diagram and data description for the prototyping process

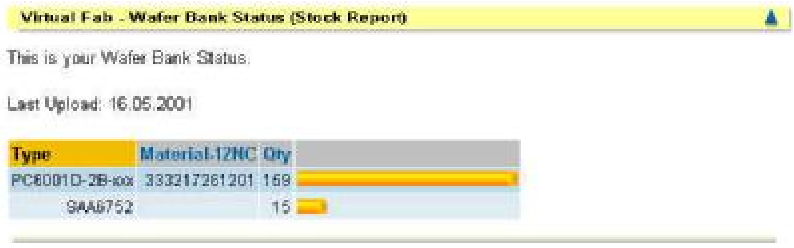


Virtual Fab - WIP-Report

This is your WIP-Report. Number of batches: 195
Last Upload: 16.05.2001

MAG	Priority	Stage	12NC	Type	Batch	Qty	Hold/ [d]	Order No.	Startdate	confirmed	expected
	4	RP01_ET			S90668.1	19			2001-01-18	0000-00-00	on time
	4	SN1_DP			S91033.1	25			2001-03-19	0000-00-00	on time
	2	CO1_ET		**88E6050-T2.8A**	S65003.1	6			2001-05-05	0000-00-00	2001-05-23
	4	PO1_PH		88E6050-T2.3A	S65003.6	6	Y		2001-05-05	0000-00-00	hold by customer
	4	N-LDD2_PH		88E6050-T2.3A	S65004.1	6			2001-05-10	0000-00-00	2001-05-26
	4	PO1_PH		88E6050-T2.3A	S65004.3	6	Y		2001-05-10	0000-00-00	hold by customer
	4	PA1_PH		**BCM3250**	S60022.4	1			2000-11-24	0000-00-00	on time
	4	VA1_PH		BCM3250	S60022.7	2			2000 11 24	0000-00-00	2001-05-27
	4	CO1_PH		BCM3250	S60029.4	11	Y		2000-12-28	0000-00-00	hold by customer
	4	ME1_SPU		BCM3250	S91079.3	1			2001-03-29	0000-00-00	on time

(a) WIP report



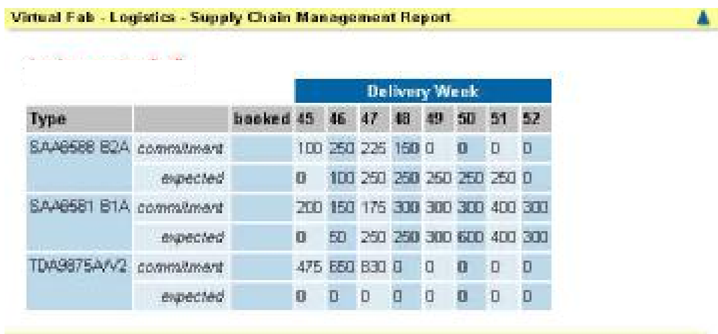
Virtual Fab - Wafer Bank Status (Stock Report)

This is your Wafer Bank Status.

Last Upload: 16.05.2001

Type	Material-12NC	Qty
PC6001D-2B-xx	333217261201	169
SAA6752		15

(b) STOCK report



Virtual Fab - Logistics - Supply Chain Management Report

			Delivery Week							
Type		booked	45	46	47	48	49	50	51	52
SAA6588 B2A	*commitment*		100	250	225	150	0	0	0	0
	expected		0	100	250	250	250	250	250	0
SAA6581 B1A	*commitment*		200	150	175	300	300	300	400	300
	expected		0	50	250	250	300	600	400	300
TDA9875A/V2	*commitment*		475	650	830	0	0	0	0	0
	expected		0	0	0	0	0	0	0	0

(c) SHIP report for supply chain management

Figure 12 SSM Virtual Fab snapshots

Table 1 Problems associated with current SSM processes

a. Non-value added:

- Doing much clerical work on checking status of products for customers rather than ensuring that order cycle time is met
- Filing customers' purchase orders
- Generating sales order numbers
- Passing sales order numbers to other departments to tie in with their order forms

b. Waste of resource and time:

- Duplication of duties (answering customer's enquiry in both Customer Service & Customer Engineering departments)
- Repetition of sanitary check whenever there is a change of customer requirements

c. Slow order confirmation time

- Cycle time for every sanitary check is approximately 24 hours

d. Service level not up to expectation

- Customer has to switch between departments should he has enquiry pertaining to ordering of existing vs. new products

e. Error-prone environment due to paper flow orders and manual data processing