Chapter VIII

A Reference Model for Industrial Enterprises

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Abstract

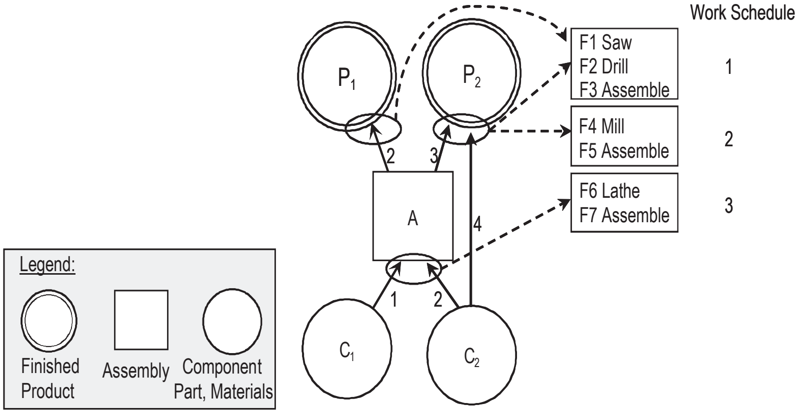
The introduction of the CIM concept approximately 20 years ago paved the way for holistic examination of logistical and engineering processes alongside the integrated support of information technology within the industrial sector. With the advent of new business management ideas and technological developments, CIM has gradually been developed further and become more integrated with complementary and contemporary concepts. Reference models are developed for the aim of using the CIM concept. The Y-CIM reference model is now established and recognised as a standard reference model within the industrial sector. Furthermore, other sectors are increasingly having success with the Y-CIM reference model in order to benefit from improved competences acquired in the industry during the last few decades. In recent years the Y-CIM reference model has gradually transformed into a comprehensive reference model that can be applied in a number of sectors. This chapter focuses on the development of business process concepts within the industrial sector and critically discusses the changes made to them over time. There is particular emphasis on the development of CIM and its implementation using the Y-CIM reference model. The article

also illustrates the features of the Y-CIM reference model and discusses its applicability in service industries.

Development of CIM

At the beginning of the 1980s, CIM was the catchword for an apparent revolution of industrial business process management. It refers to the integrated information processing requirements for the technical and operational tasks of an industrial enterprise. It is the computerized handling of integrated business processes among all different functions in an industrial enterprise, the consistent application of information technology, along with modern manufacturing techniques and new organizational procedures. Industrial enterprises rationalized their production and development processes in order to increase process efficiency. The support of business processes with information technology led to an essential boost in process efficiency. At first, the use of information technology for well-defined and isolated business fields by enterprises led to isolated applications solutions. The introduction of the CIM approach prompted industrial enterprises to adopt an integrated view of logistic and development processes coupled with integrated information technology support. CIM embraced integrated information processing for business and technical tasks in industrial enterprise. It therefore aimed to unite logistical processes with the research and development processes (R&D) within an industrial firm and to support them with integrated information systems. The CIM concept was a logical further development of both high process competences in industrial firms for the development of new products and of manufacturing at factory level. The importance and complexity of such products meant that a high level of competence was necessary in both fields. In order to develop industrial products such as cars or machines, up to several thousand employees may be required: for research and development departments, for constructive improvement, building prototypes, planning production and factory building. In no other branch has business process been so formally thought-out (a DIN[1]-norm is even defined for it). The creation and testing of production processes lasted a number of decades. The revolutionary idea of depicting product structures without redundancies using bills of materials made the complexity of industrial processes transparent and comprehensible. A bill of material is an itemized listing of the parts of a product with material quantities (Stewart, 1991, p. 93). Thus, bills of materials record the structure and quantitative composition of end products from intermediate products and raw materials (see the product tree below). For the description of bills of materials Gozintographs are used. A Gozintograph presents each part and each structural relationship only once in order to avoid redundancy (Scheer, 1991, p. 189). Work schedules were also used to develop a business process description for the production of individual components of the list. Industrial engineering methods originating from the USA and the production planning and work preparation methods that were developed in Germany have gained much recognition. Reducing an entire business process description to descriptions of product structure and work schedules remains exemplary for other sectors. Through strong structuring of products (bills of materials can for example include several thousand components in the motor industry or in mechanical engineering) each business process description (work schedule) is reduced to a small sub-process. Put simply, the entire business process description from the raw material to the final product

Figure 1. Product and process model (Scheer, 1999, p. 59)



is divided into a description of product structure and work schedules. The complicated flow of material is contained in the product structure. The work schedules simply give the sequential working steps between two product stages. Work schedules for specific parts in manufacturing processes are detailed documents, since process descriptions are not only used to support fundamental organizational rules, but also to implement processes directly (Scheer, 1999, p. 59). Bills of materials and work schedules describe the composition between product and process models effectively.

Figure 1 depicts a bill of material and work schedule describing the composition and production of finished products (P1, P2). P1 and P2 consist of assemblies (A) and component parts (C1, C2). The work schedules that reflect the working stages which have to be carried out contain the production processes. In the work schedule, manufacturing processes are

Figure 2. Bill of material list (Knox, 1984, p. 266)

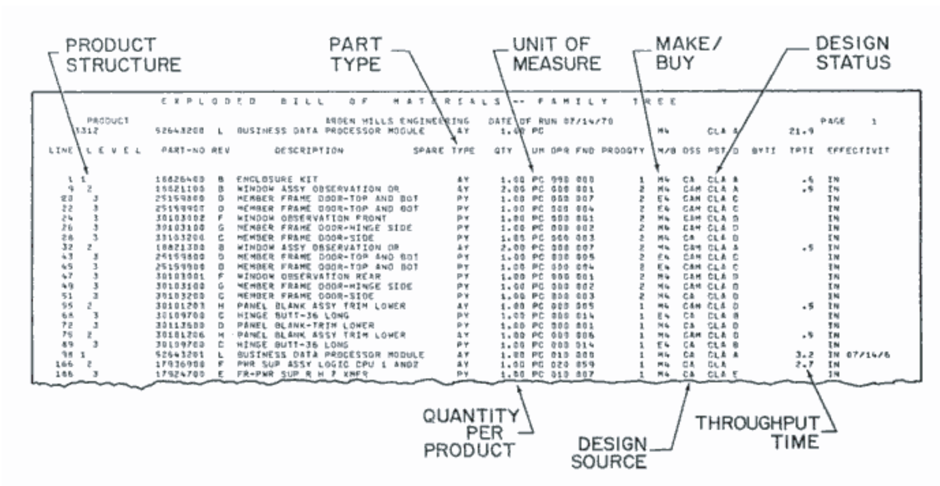
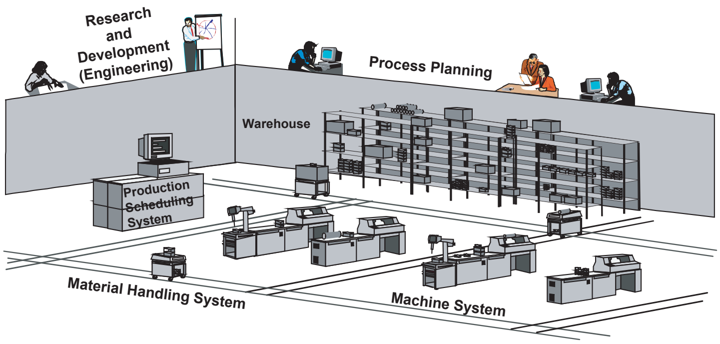


Figure 3. Industrial production system (Scheer, 1999, p. 110)



allocated to every part to be manufactured. In order to set up a work schedule it is necessary to know the product model. The work schedule comprises the operations (functions) to be executed in order to assemble the materials, parts, components, etc. into a finished product. The process model can therefore be derived to an extent from the product model. The manufacturing of the product model requires the execution of the process model. Bills of material show the structural and quantitative assembly of the final product, semi-manufactured products and basic materials. The numbers on the arrows reflect the production coefficients. For bills of materials Gozintographs are employed to avoid redundancies. The construction of parts from their components can be represented diagrammatically by means of a Gozintograph. It shows which lower level parts are used in what quantity to construct a given higher level part. The following figure shows a common type of bill of materials list used in an industrial enterprise.

As later illustrated, the Y-CIM reference model uses bills of materials and work schedules to connect logistic and engineering processes used from both fields.

Development Stages of CIM

Production within the industrial sector is highly developed, not only due to product and process descriptions, but also because of the structuring of the production system itself. Figure 3 depicts both aspects—the structuring of products and processes as well as systems.

The system is divided into sub-systems: stockrooms for those components still to be processed, a processing system consisting of machines and employees and the link between both via a transport system reduces the complexity and increases the transparency of the system. A control panel ensures that the respective process status is known and will be used for controlling the system.

The CIM concept aimed to transfer this high competence of process description and control to all areas within an industrial enterprise. Both the planning processes and the processes involving external partners of the enterprise (i.e., suppliers and customers) are included. The basis for this was pre-existing product and process documentation in the form of work schedules and bills of materials. These form the connection between the R & D process and logistic planning. The bills of materials show the prognosticated demand of the final products and are therefore required to ascertain which external materials are needed for the procurement process. The work schedules form the connection between the planned production quantities and the required capacities. In this respect, CIM also met the demand for an integrated database, since it placed the research and development function, the planning requirement calculations and the capacity considerations on one unified database. Although data are distributed among various components of a CIM system, it should be logically centralized in order that the whole system can be found within a single database. The information from the bills of materials and the work schedules is generated in the research and development process, so that there is an automatic connection to IT-supported construction systems, such as computer aided design (CAD) and computer aided engineering (CAE). CAD offers the designer information technology support in order to design and create products. In the process he can call up drawings, for example, of already existing parts from a database and amend them or combine them with other drawings to create new drawings. The call-up and further processing of previously stored drawings secures a considerable rationalization (Scheer, 1991, p. 201). CAE offers functions to support engineering tasks. In addition to graphical CAD capabilities, the possibility of developing prototypes within the computer can largely replace the creation of real prototypes. Thus, there is a huge possibility to cut costs.

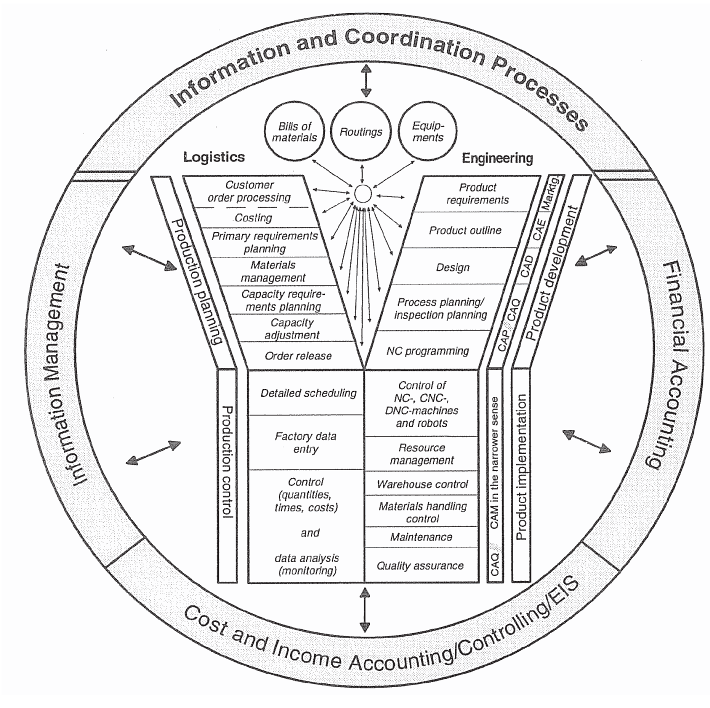
Moreover, the data can be easily accessed during the implementation stage. At factory level, the production control information, derived from logistic applications, runs alongside the product information. A machine controlled by numeric control (NC) needs to know how many units it has to produce (information from the order chain) and which geometric contours it should process (information from the product description of a CAD-system). In general, CIM can connect the automation technologies of manufacturing processes, such as robotics and NC machine tools, with the computerized product and process design, and automated planning and control (Rainey, 2005, p. 402).

Y-CIM Reference Model

The implementation of CIM requires a reference model that can meet industry-specific requirements. In general, the most important requirement for such a reference model is its ability to consider and allow the integration of logistic systems, including all of its sub-systems (procurement, production and distribution logistic are some examples). Full integration of all logistic systems from planning level up to product scheduling is required. An integrated perspective between the logistic and engineering fields is also essential, since there are close links between these two core areas. Moreover, there are interdependencies between logistics and engineering. As regards the former, bills of material and information concerning work schedules (produced during product planning) are needed for production planning aspects, such as requirement planning, time and capacity management, etc. The initial tasks of capacity management are to carry out capacity scheduling, in which production orders and work schedules are combined (Scheer, 1994, p. 25). The production planning depends to an extent on product planning. As regards engineering, product manufacturing depends to some extent on production scheduling, since this is used to control manufacturing. Interdependencies can occur mutually between both fields. The reference model should take account of this approach and ensure that pre-existing bills of materials and work schedules can be used to attempt to link the core industrial functions—logistic and engineering. It should also be considered that logistic and engineering processes can be affected, for example, by information and coordinating processes, accounting, etc.; an effective reference model is one that takes this into account also. In order to set up an integrated and holistic industry-specific beneficial solution, the reference model must be able to cope with the described requirements. There should be guidelines on how to set up an appropriate solution that is capable of handling computer-based processes in an integrated way within all of the various functions in an industrial enterprise.

The Y-CIM reference model fulfils all described requirements. By interlinking business and engineering related tasks, it offers a conceptually outstanding frame for CIM (Ferstl & Sinz, 2001, p. 233). The Y-CIM reference model is renowned for its unique ability to implement CIM in practice. Considered to be the industrial standard reference model for implementation of CIM, the Y-CIM reference model was developed by Professor Scheer in 1980. It illustrates the integration of and relationship between the core industrial fields in a clear and graphical form. The Y shape reflects the core industrial functions by illustrating the business and engineering related components and the relationship between them. The integration concept aims to integrate business and engineering related functions in an industrial enterprise. The left side depicts business related functions whilst the right side

Figure 4. Y-CIM reference model (Scheer, 1998, p. 93)



relates to engineering. The bottom of the Y stands for the integration of both fields. This reference model can be used to integrate business and technology oriented information systems within an industrial enterprise (Fischer & Herold, 2002, p. 81). The integration of logistic and engineering systems, as well as processes, is the main objective. It has been used successfully in many enterprises as a guideline for the development of their own integration strategies. Y-CIM is one of the most popular reference models to define CIM (Jost, 1993, p. 7). It remains valid nowadays and is used in many industrial enterprises. There are a wide range reference models available. An overview is provided by Fettke and Loos's reference model catalogue (Fettke & Loos, 2004). Moreover Y-CIM is transferable even in other domains such as service industry and public administrations. This issue will be discussed at a later point in the paper. Figure 4 illustrates the Y-CIM reference model.

The left part of the Y-CIM reference model concerns mainly business related issues. It describes production planning and control systems (PPC), primarily from the business-oriented planning view. PPS is able both to take over planning functions and also administer bills of materials, work schedules and manufacturing facilities. The upper left part focuses particularly on production planning, while the lower left part refers to production control. This is important due to the high quantity and complexity of the data to be managed. The left side concerns functions which are controlled by the flow of the customer order processing via requirements planning, time management, manufacturing control, industrial data capture and shipping. The production logistic therefore consists of the functions of order processing and distribution logistic shipping. At the same time requirements planning includes procurement logistic. In general, PPS deals with the entire process of planning and execution of production orders such as material logistics, production planning and production control. Sub-systems of production planning and control are interlinked apart from each other with other operative systems and technical components such as CAD, CAP and CAM (Stahlknecht & Hasenkamp, 2005, p. 360). One area of any CIM system is the linking of CAD and CAM (Waters, 1996, p. 7). Between each of these functions information exchanges can be based on a common basic data management or, in best case, an integrated database (Alpar et al., 2002, p. 216). In chemical, pharmaceutical and food industries, the production planning and control require a different approach since they focus more on recipes and charges instead of parts (Stahlknecht et al., 2005, p. 356).

The upper right part of the Y-CIM reference model focuses mainly on engineering-related objectives. It reflects output and product development processes, including all necessary documentation. It includes technical support components such as CAD, computer aided planning (CAP) and computer aided manufacturing (CAM). CAD includes computer aided compositions, drafts and constructions of products. The CAP task is to support conventional work scheduling and NC controlled manufacturing facilities (Alpar et al., 2002, p. 218). By contrast, CAM deals with computer-based manufacturing and improvement of internal material logistics. The loose connection of the upper part (logistics and engineering) of the Y-CIM reference model is based on commonly used data (logistics and engineering) such as bills of materials and work schedules, which arise or are generated through the product development.

The lower right part of the Y-CIM reference model contains computer-based resources that are required for product engineering. The control of these systems demands the description of the products which they produce. Apart from the informational relationship between product development and implementation, there is also a close short-term relationship between manufacturing control and feedback system of the industrial data capture. The production orders that are defined within the production logistic are merged with the description data of the output development and carried out using the manufacturing facilities. Due to the close relationship between the short-term manufacturing control and manufacturing resources, the description of them is processed at that point as far as necessary to establish understanding for business issues. There is also a relationship through the description data of output purchased and distribution required by procurement and distribution logistic processes. The right part of the Y-CIM reference model contains technical systems but also possesses high business meaning. It deals with economical issues and technical alternatives in order that an efficient solution may be set up (Alpar et al., 2002, p. 218).

Various systems inter-linked with the business and technology related systems or processes (logistic and engineering fields) are depicted in the area surrounding the Y-CIM reference model. The business and engineering based information systems' alignment to the corporate objectives through the information and coordinating systems is illustrated. The operative data from the primary processes are used as input information for information and coordinating systems. The operative systems are concurrently data suppliers for the financing, cost and activity accounting systems and for information management, too. Financial accounting reflects the business processes of the corporation with its environment from the value view. Thus, it is also called external accounting. By contrast, internal accounting focuses on the value of used input resources in order to check and control output production. The information management develops concepts for the provision of resources, applications systems and their operation.

The demand for integration and computer-based support of business and engineering-related functions of CIM is fulfilled by the Y-CIM reference model. The interlinking of administration and disposition systems in particular (e.g., financial, cost and activity accounting and order processing with product planning and control through the use of technical oriented systems (CAD, CAM, CAP) and the access to an unified data pool of a common database) leads to the aimed integration purpose (Alpar et al., 2002, p. 218). Thus, the integration takes place mainly via commonly used basic data such as bills of material, work schedules and operating resources (Hansen & Neumann, 2005, p. 89). That means that the conjunction between logistic and engineering is established through description data such as bills of materials and work schedules. The integration is achieved mainly via function and data integration (Fischer et al., 2002, p. 378). Data integration is realized because different functions and components of the Y-CIM reference model use the same database. This leads to the avoidance of redundancies (Blazewicz, Ecker, & Pesch, 2001, p. 425). The information interrelationship between production planning and product engineering is carried out via product data descriptions. They are used by NC-based control of manufacturing facilities. Moreover, there is also an information connection between the short-term manufacturing control and feedback system. The integration of the Y-CIM reference model demands willingness on the part of enterprises to agree on organisational integration requirement challenges. Just-in-Time, kaizen and lean production are some of the challenges that are partially, but not completely, included in the CIM approach (Stahlknecht et al., 2005, p. 354). The Y-CIM reference model is able to meet these challenges since its holistic and integrated view on enterprises enables enterprise to implement innovative concepts more efficiently and effectively. Beside that, it is also able to identify the processes that need to be changed for successful implementation of such concepts (Kirchmer & Scheer, 2003, p. 6).

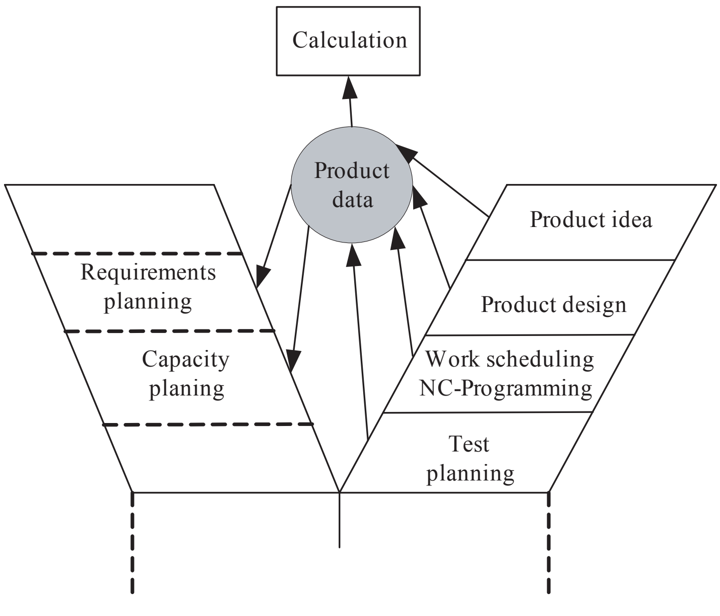
Generally, it is possible to incorporate and support emerging new business or engineering concepts using the Y-CIM reference model.

The various interdependencies between corporate processes and the different quantity and value-oriented views make it difficult to depict the design of the Y-CIM model simply. The Y-CIM model, with its basic and enhanced version (which ensures integration of information and coordination systems), should therefore be understood as a raw graphical guideline. Despite the handling of sub-processes, it contains an integrated and holistic view on processes. An outline of the development process using Y-CIM follows next.

Example: Output Design Processes with Y-CIM

The design of new products is one of the most challenging topics in industrial companies. Due to globalisation, industrial over-capacity, shift from vendors to customer market and shrinking product lifecycles, enterprises are under pressure to design and introduce new innovative products into the market (Bussmannm, Jennings, & Wooldridge, 2004, p. 41). At the same time, the development time of products is one of the most important factors for success in the market. Product development is increasingly becoming the most important decision centre of an industrial enterprise. Product development predefines important parameters for the proceedings of the logistic chain and expense situation of an enterprise. Concepts that are developed for product design cannot be realised efficiently without in-

Figure 5. Extract of the Y-CIM reference model (Scheer, 1998, p. 532)



tegrated information technology support. The close interrelationship between organisation and information technology is evident.

Product development is illustrated on the right side of the Y-CIM reference model. The figure indicates that product development can be described from different views. The marketing view defines the product requirements within the product idea phase. Marketing mainly involves finding out about customers' attitudes towards product features. The product design phase has the task of developing the technical features of the product and describing them with topological-geometrical data. The manufacturing unit plans the procedures that are necessary in order to produce the product using work schedules. Quality assurance describes the quality features of the product. Defined test procedures and test plans should ensure that the target quality level will be met.

Descriptions related to products that are produced during product development are called product data. As far as bills of materials are concerned, product data controls the requirements explosion within the requirements planning. It also controls capacity planning where work schedules are concerned. At the same time, these data are fundamental for product calculation. It is therefore clear that product development belongs to the main "data production centre" within an industrial enterprise.

The terms used in the previous figure relate to manufacturing industries. They are, however, also relevant for process-oriented manufacturing, including chemical and food industries, since these process procedures are mostly analogue. In these sectors, the term "product design" is replaced by the term "research and development," while "work schedules" are called "production specifications." They are also named together with the product composition as "recipe." The production team should consider the entire product lifecycle when developing the product. During the product development phase, the following stages in the product lifecycle must all be considered, so that the later effects of decisions made at this point can be predicted. Considering these effects during product development phase avoids expensive and time consuming product corrections.

Lack of Preconditions in the Past for the Implementation of CIM

Unfortunately, the term CIM fell into disrepute in the past. This is not unusual. A new catchword often rouses expectations which cannot be fulfilled in a short period, with the result that optimistically drafted projects end in failure. This was the case with CIM. At that time, the use of databank systems to integrate logistic and product-related information systems, as well as production support, was not widespread. Furthermore, there existed no corresponding networking possibilities that were developed enough for the system. Even integrated standard software wasn't available for all areas. The CAD software system had an independent existence and those responsible for system development generally had no competence for logistic systems and for the real-time requirements of carrying out production. The planning and logistic applications were entrusted to suppliers of commercial software systems. These suppliers too had little or no competence for the product development processes and carrying out production, and the CIM-large projects were unsuccessful. This was also the case with the MAP-Programme (Manufacturing Automation Protocol) developed by General Motors, which aimed to standardise the CAD-system. The standardisation of networking various production systems (quality assurance, checking system, production management, CNC, DNC, etc.) should have been hugely successful, since the "crème de la crème" of information technology and industrial customer power were combined. These developments made it difficult to exploit the potential of CIM in practice. There was therefore no opportunity for the potential of the Y-CIM reference model to be exploited at that time.

The lack of success of these projects demonstrates how the enterprises of that time were overwhelmed by their vision. The failure of a vision doesn't, however, mean that it was not correct. Thus, many approaches from the CIM-conception of that time have become highly significant in today's business and industrial world. Similar ideas with different names have been introduced.

Connecting planning functions and the execution level through hierarchical production planning- and control-systems using client/server architectures, whilst not a complete success, has achieved near success. The inclusion of customers and suppliers in the processes is being developed further through the concepts of customer relationship management (CRM). In contrast to that, CIM was mostly concerned with intra-enterprise interactions (Vernadat, 1996, p. 3). The major idea of CIM was the effort to define and develop large, monolithic software systems that could manage many points of internal manufacturing process integration. The inability to do this was the main weakness of the CIM concept (Blazewicz et al., 2001, p. 116). Put simply, the extensive CIM concept has been broken down into small concepts for sub-processes, whereby even their integration will continue to be tracked. This leads to a potentially new field of application for the Y-CIM reference model. The importance of complete integration can even be seen in market developments. Initially successful software suppliers for sub-solutions such as CRM or supply chain management (SCM), for example Siebel, were being forced back by suppliers of enterprise resource planning (ERP) software. In the case of SAP, this was because their solutions also include the integration of these sub-processes with the backbone-processes of internal order processing, commercial systems of financial accounting and controlling. The basic idea of CIM was taken up into ERP systems without being explicitly mentioned (Mertens et al., 2005, p. 354).

Applying Y-CIM in the Service Industry

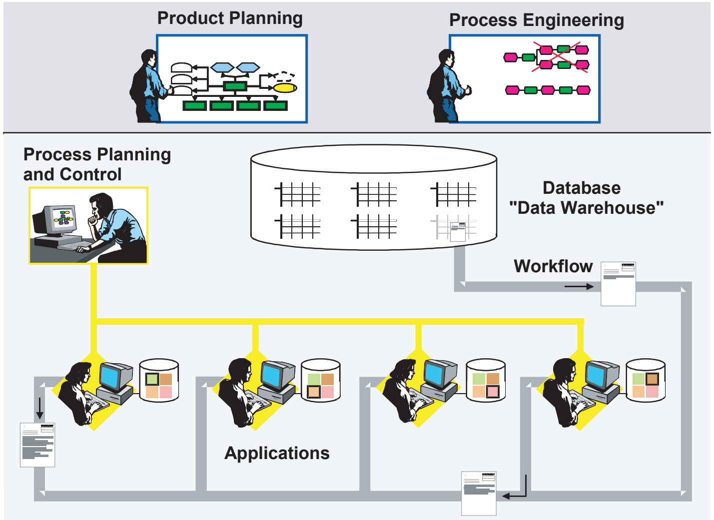
Service engineering describes approaches, methods and tool support for systematic planning, development and realisation of services products and processes. The object of this engineering approach is to increase effectiveness and efficiency of the development process and the quality of service itself. In contrast to this, product engineering focuses on the systematic development and planning of physical products from the first idea until the realisation of the finished product. One of the core differences between industrial and service enterprises is in the type of production planning process. In industrial enterprises, production planning is mainly based on customer orders. In general, this is not the case in service industries because services are normally not storable. Services usually are simultaneously produced and supplied. The production planning is based to an extent on estimations that can be derived from former experiences and prognoses. The production planning of services, which do not contain material elements, are usually designed independently from the existence of customer orders.

Received customer orders only influence production control because of the integration necessity of external factors into the creation process. In consideration of the customer relationship, there is a close analogy between system structure of an information technology-supported service process and the structure of production process in an industrial enterprise. In service industries the production of service is strongly supported by information technology. The information technology used corresponds approximately to the machines employed within an industrial company. The data which is necessary for service engineering is stored and managed in a data warehouse which is reminiscent of the storage system of an industrial enterprise. The link between the data objects and the processing functions as software modules is established in a service factory via a workflow management system which is like a transporting system in the industrial sector. The transparent control of single process executions is also achieved through a monitoring and analysis system. The transfer of industrial concepts and methods in order to get a more transparent control of processes in the service sector requires on the one hand the systemization of the service structure, and, on the other, the documentation of the processes that are necessary to produce the service components. Beside that, there is a need to organize the integration of external factors into the service production process. Up to now, the implementation of the systematic and information technology supported development of services that are bases to some extent in difficulties to describe output, processes and potential dimensions of services. In order to cope with these challenges, there is a need for a methodical concept that deals with the issues. These challenges can be met using the Y-CIM model as described in the following paragraph.

The integrated and holistic issue of business processes remains highly topical and exciting. Not only does the Y-CIM concept help to shape business processes in industrial firms, but also many of the ideas related to it are being communicated to and discussed in other areas—from services enterprises to public administrations. Twenty years of CIM and business process optimisation in industrial firms is producing its fruits now, and will define the future of organisations and information processing in other branches too. The industrial competencies (developed during the last decades) concerning integrated product and process design can be transferred to business processes of other branches because of existing analogies. The Y-CIM reference model is also applicable within sectors apart from the industrial one. The basic concepts derived from the running of typical industry processes can in principle be transferred to any organisational structure. The analogy becomes clear when using terms such as “service engineering,” where the industrial development of new products can be transferred to service enterprises such as banks, insurance companies and even—to some extent—to public administrations. Even service enterprises are increasingly falling under pressure to quickly develop new variations of an existing product or to create new, innovative ones. Until now it has rarely been customary for these enterprises to therefore define departments and formal procedure methods. This is, however, becoming necessary due to the short lifecycle of products and higher diversity of variants. For this reason, the experiences and organisation concepts such as simultaneous engineering and concurrent engineering are valuable information sources for the reorganisation of service enterprises. The term “credit factory” even refers to the fact that banks are behaving increasingly like industry enterprises. There is a close analogy between the system structures of an IT-supported service process and the structure of an industrial firm.

Although service enterprises structure their products more strongly and document the processes required to generate product components, they have the same initial situation as industrial enterprises for the transparent control of processes. In service enterprises, the

Figure 6. Service industry product and process design



"factories" are shaped to a large extent by electronic information systems. Computer systems form a quasi machine level for supporting the execution of functions. The data objects to be processed (i.e., documents) are administrated in databases. Here, the term "data warehouse," understood in a somewhat different sense, can build up an analogical relationship. The link between the data objects and the process functions in the form of application software modules is created by a workflow system in the form of a transport system. The transparent control of individual processes is also achieved using a monitoring and analysis system as described above.

As a result of the analogous utilisation of industrial experiences, expertise within the field of service engineering has increased in recent years. It is beneficial to use industrial approved methods and approaches in order to achieve systematic and efficient production of services. IT support of the service engineering process is necessary in order to exploit partially unused success potentials. Software supported service engineering can be carried out systematically with adopted industrial methods and approaches. Company-wide unified documentation of product (service) and process structures, and their storage in a centralized database, allow the work of service suppliers to be standardised. The aim is an information technology-based holistic and integrated support of service engineering and the supply of services. The Y-CIM reference model is applicable in the service industries with a few modifications (Herrmann & Klein, 2004, p. 182). There are close analogies between both fields. The service industry can learn from long term experiences in planning, control of production as well as development and implementation of products from the industrial sector. The amount of experience gained using the Y-CIM reference model is useful in enhancing the efficiency of service engineering. Service enterprises are behaving increasingly like industrial ones. The analogies between industrial and service sectors enable the use of the Y-CIM reference model within the service industry and thus provide an opportunity to achieve comparable benefits like those found in the industrial sector (Krämer & Zimmermann, 1996, p. 555).

Unified BPM Supported by Y-CIM

Thus, the circle comes to an end: At first the industry required structuring of the development process for areas in which the processes are particularly crucial because, for example, their optimisation helped to amortise high sums in mechanical facilities investment, and the high complexity of products demanded stronger structuring in order to reduce complexity. The competences developed during the last few decades are now being transferred to all business process types in order to benefit and accelerate progress. Industrial enterprises also carry out service processes. This means that the concept illustrated in Figure 6 is valid for administrative business processes such as procuring, sales and commercial support in industrial enterprises. A unified concept can therefore be used within industrial firms for supporting business processes. Service enterprises are behaving increasingly like industrial enterprises. We are on the way to achieving a unified business process management concept. The Y-CIM reference model makes a great contribution towards implementation of this type of concept. Y-CIM stands for an integrated process view which is the requirement for business process excellence (Jost & Kruppke, 2004, p. 13). The first results of such a solution can be seen in the ARIS-HOBE approach (Scheer, 2000, p. 3).

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Endnote

1 German Institute for Standardization (DIN)