Analysis, Planning and Implementation of CIM applications within SME's with the CIMple Toolbox

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SYNOPSIS

It can hardly be contradicted that there is a growing complaint about mismatch between the potential performance of CIM solutions available and the practical success score in implementing CIM in the Small and Medium-sized Enterprises (SMEs). This paper assumes that one reason for this discrepancy lies in the heavy-handedness of the planning methods and tools available to consultants while planning CIM implementation in SMEs. It describes after justification of this assumption the part of the CIMple methodology and software called FTM (Fast Track Modelling) which specifically adresses the support of SME's.

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1 Introduction

From a technical point of view all problems with CIM seem to be solved: a stroll through SYSTEC gives one the impression, that any wish for computer support can be fulfilled. There is supporting software available for every function or department of a company, and all of these products can easily be integrated into complete CIM-systems - at least that's the assumption. The impression is being created that anyone wishing to introduce CIMple can simply buy everything that is necessary. Once at home, everything will be implemented, the employees will be trained and everything will be just fine.

Meanwhile it has become common knowledge, that things are not actually that easy. For that reason we would like to deal with the question of how to make the most reasonable and economical choice from a steadily growing selection.

This question is not easy to answer, however, and presents even the theorist with a mostly unsolved problem. Not even the costs of CIM-implementation are known in detail, because in addition to the prime cost of hard- and software one has to take into consideration costs for training, changes in the general organization, friction loss etc.

It is even harder to assess CIM's benefits. Generally the benefit is seen less in cost reductions than in the possibility to improve the company's position on the market. But how does one estimate an improvement of that kind?

For that reason we have the problem that it is not possible to render a traditional cost-profit-evaluation, because the costs can only roughly be calculated, the profit even less so. How does one justify an investment like that? If one also takes into account the risks connected with the implementation of CIM, especially for SMEs, then the question whether CIM might only be suited for large corporations seems to be justified. Can small and medium-sized enterprises afford something like CIM at all? On the other hand one also has to ask whether they can afford to ignore the development concerning CIM.

It is well known that especially the automobile industry expects their suppliers to use the same software in order to be able to easily exchange data. Those who do not adjust to those requirements are in danger of losing their contracts with the large, market dominating companies.

Many small and medium-sized enterprises therefore simply have to apply CIM if they want to survive. In view of the typical investment frame for CIM on the one hand and the considerable insecurity involved on the other, planning and evaluation strategies are necessary which will make it possible to asses the consequences of a CIM-solution in the planning stage and which will take into consideration the market situation, finances and the social and qualificational range of a company. This task cannot be completed by one single method or one single software tool. The adequate planning and evaluation of CIM can only be accomplished by a pool of tools and methods. An idea like that has been chosen for the ESPRIT project 5424, called CIMple. Different software packages have been developed as well as a method for the integrated application of those tools.

2 The idea of CIMple

The starting point of the project was to give especially small and medium-sized enterprises support concerning the planning, evaluation and selection of CIM-systems and system components.

By using CIM the companies expect, among others, the following advantages:

- better position on the market
- faster product development
- higher degree of flexibility
- less turnaround time
- higher product quality

- lower stocks and
- lower profit-related production costs

The following risks have to be considered regarding the investment in computer supported and integrated manufacturing:

- high degree of capital intensity, which might surpass the financial possibilities of medium-sized companies
- the traditional work structure within the company has to be changed
- the employees will have to fill requirements for new qualification needs
- synergy effects will occur and their effects on other parts of the company are often difficult to detect
- synergy effects and quality gain caused by CIM-investments are difficult to assess and to verify
- uncertainty concerning the future technical development, new specifications and standards lead to questions about the system selection and the best starting point for the application

Furthermore there are several obstacles to the decision regarding CIM investment. Daily business, which is often a fight for survival, keeps small and medium-sized enterprises from doing the necessary planning and selection of CIM investments. Sometimes the company is not focused on its goals any more or those goals are no longer well defined or adjusted to the current situation. The market is neither being analysed routinely nor influenced by the company. It is not clear which CIM concepts would be necessary, which requirements they would present to the organization and the company lacks a general, economical basis for the decision.

In CIMple the answer to the complexity of CIM investments is an integrated investment analysis system. It consists of a "CIMple Toolbox", which contains various software tools for the analysis of the company and for the development of a CIM concept. The results are further processed by "Solution Workbench" and with its help a specific CIM solution using CIM components already available on the market will be developed. Those two packages correspond to the "Configuration Auditor", which will examine the results and the efficiency of the CIM configuration according to the company's specified goals. The results will then be presented to the user in graphic form.

The above mentioned tool sets are incorporated into the "CIMple Worksheet", which controls the various tools and documents of the CIM implementation project. It also contains a Guided Tour, which leads the user through the CIMple program using the CIMple method CACIMI. The entire CIMple package works as an integrated program system, based on the CIMple data base, which contains all relevant data concerning the software tools and all informations necessary for the CACIMI method. CIMple has been developed in the SCO-UNIX system, but will also be available for Windows in the near future.

The CIMple method "CACIMI"

The CIMple method "CACIMI" - Computer Assisted CIM Implementation - functions as a guide for the efficient use of the various CIMple tools. CACIMI supports the application of CIMple and leads the user through the various project stages. This tool will provide information about the questions that can be solved by CIMple and about the solutions provided by each single tool. CACIMI provides clues for the software selection regarding a specific application and contains information for the integrated application of CIMple; which results will be generated by each single tool and how or where these will be used as input in other tools. Furthermore CACIMI introduces the user to the selected tools.

This method defines four project stages for the implementation of CIM:

Stage I: Definition of the position and identification of the problem.

In this stage CIMple will define the company's goals, analyse the current situation and development of the company and identify its weak points.

Stage II: Development of the CIM concept and its evaluation

Alternative strategies for the CIM solution will be developed and will be roughly evaluated from a general perspective as well as from a detailed production point of view.

Stage III: Selection and detailed specification of the CIM solution

The previous general CIM solutions will now be specified in detail including the selection of software products.

Stage IV: Control of CIM implementation

Every stage of the implementation will be accompanied by subsequent examination. Resulting adjustments of the implementation plan including a new evaluation will be carried out.

3 Working with CIMple

The CIMple method (CACIMI) shows the application of the tools according to each specific case. Two different CIMple applications can be roughly identified. If the user rather wants to develop a CIM solution based on generic data in a very short time, CIMple offers the FTM package (Fast track modelling). It is aimed at companies which do not need a deep analysis, but would like to implement their CIM solution as soon as possible. FTM therefore works without a large amount of company modelling and analysis. The CRM package (CIMple Rigorous Modelling) on the other hand uses the entire potential offered by CIMple.

For this reason we would in the following like to illustrate the FTM package first and the CRM subsequently.

3.1 The Goals of FTM

"Why should we pay 60, 80 or 100 thousand DM for a consulting service, if we only get a lot of paper and some vague recommendations in the end? We would rather go to some fairs instead and find an acceptable solution that way. And the vendors will help us anyway, and free of charge at that!"

Whether or not this opinion is justified is not the point right now. But it cannot be denied that many companies which do not yet have integrated DP-solutions share this opinion. And those companies which have already implemented a DP-solution are mostly not able to get away from the suppliers which have provided the existing solution. The consequences are in both cases passivity and resignation concerning computer supported information processing although information is being regarded as the most important competition factor in all manufacturing branches.

It cannot be denied that CIM consultants are currently not able - and sometimes not even willing - to provide transparent and controllable consulting services for their clients. There are several reasons for that:

The most important factor is the lack of a system or, in other words, of a standardization regarding CIM consulting services. The current standard of CIM consulting services can be compared to the method of an architect who designs a house for his client without any technical drawings and who hands over to the bricklayers and other craftsmen nothing but a rather detailed piece of writing. Just as the future house owner would have to blindly trust his architect the CIM user of today has to rely solely on the personal qualification of his consultant. Although the professional CIM consultant now uses a variety of checklists and analysis tools in defining the situation and the requirement specifications their contribution to selecting a solution is a rather modest one. The following reasons can be identified:

1. Lack of a common basis of understanding among the consultant, the supplier and the user.

A DP product requirement specification consists largely of verbal descriptions, which are, at their best, well structured. But verbal descriptions cause misunderstandings because of different interpretations of their content. The danger of misinterpretations grows erratically according to the size of the description. A product requirement specification of that kind can therefore not be regarded as a basis for the decision concerning the selection of a specific solution either for the supplier or the user. For that reason no serious CIM supplier would make a binding offer based only on a product requirement specification. He would try to whitewash his offer with all kinds of ifs and whens in order to meet the deadline on the one hand and to get the other side to specify the requirements on the other hand. The actual specification of the requirements begins only after that, but will not be incorporated into the product requirement specification. That means that this specification cannot be used later for the validation of the CIM solution after it has been implemented in the company.

From the client's point of view the product requirement specification is therefore not very useful, especially since he does not derive any permanent gain from the previous analysis process either. This is the case when the consultant conducts the analysis

- either without any formal methods or tools

- or by using means which are difficult to understand for the client.

2. Lack of a means of documenting the consultancy results during the entire life cycle of the CIM application.

As mentioned above a product requirement specification will no longer be up to date if the specification of the requirements made during the negotiations with the suppliers are not integrated. The outdated product specification cannot even be used for the validation of the CIM solution right after it has been implemented.

It cannot be denied that even after this initial stage an implemented CIM solution has to be continually tuned in order to make adjustments to changing company strategies and technological prerequisites possible. The product requirement specification would have to be supplemented accordingly. But this is currently not the case. The product requirement specification in the client's viewpoint remains unuseful and unacceptable in terms of its price-efficiency-ratio.

3. Lack of a means for the reconstruction of the decision process.

Almost any CIM solution on the market has as one of its features the possibility to store all kinds of purchases, sales etc. This feature is absolutely necessary in order to settle claims or to anlyse the situation on the market, the client's behavior etc. But the client does not have the possibility to reconstruct the history of analysis and decisions that led to the first implementation and the subsequent alterations of his CIM solution other than by working through all the accumulated paper work. No client can be expected to invest that much time, especially in the field of SMEs, apart from the fact that in most cases he will not be able to reconstruct the decision process in this way.

The CIM consulting service therefore remains fragmentary. The history of the previous consultancy results is at no stage being systematically analysed. The consequences resemble those of a company which modernizes its sales strategy without considering the history of either its sales personnel or its client's behavior.

CIMple's goals in general and especially FTM's are to improve these weak points of the current CIM consultancy process by:

a) developing a method for a requirement analysis tailored to the need of SMEs emphasizing the the development of a common ground of understanding among consultant, supplier and user.

b) developing software tools for the support of this method, especially by implementing a data base for the client, which will make possible both the continuation and the reconstruction of the consultancy process without considerable additional efforts.

3.2 The FTM method

CIMple's FTM method is based on the following principles:

1. The client has to be able to understand the method applied in every stage of the project.
2. It has to be possible to roughly plan several planning stages in order to subsequently modify these plans if necessary.
3. The entire planning method has to be subdivided into modules so that for each given company only the relevant planning stages have to be carried out.
4. Each planning stage has to provide specific results which will help the client to decide on further proceedings.
5. We have to provide the possibility to systematically compare the requirement specifications developed in the planning process to the available CIM solutions in order to make a priority-oriented recommendation.
6. The method will be open to further supplements.

Based on those principles the following FTM planning stages have been developed:

1. Identification of the company profile.
2. Identification and evaluation of the company's objectives.
3. Identification of the global CIM requirements with regard to the evaluated company's objectives.
4. Detailed specification of CIM requirements.
5. Analysis of CIM requirements and development of an invitation for tender.

6. Evaluation of the CIM solutions offered in comparison with the specific CIM requirements.

Since a software tool has been developed for every planning stage we will not describe the 6 planning stages in detail at this point. The descriptions are integrated into the following presentation of the software.

3.3 The FTM-software

The FTM components of the CIMple system are:

- Company Specifier
- Objectives Editor &Rater (OBER)
- CIM Detail Specifier (CDS)
- Template Assembly Module (TAM)
- Vendor Solution Creation Module (VS)

Prior to the description of these tools and their underlying planning methods we would like to illustrate the integrating functions of the basic components CIMple DB and WORKSHEET.

CIMple DB is the global data base of the entire system. Each software component will deliver all of its results to CIMple DB and will receive all the necessary input data from CIMple DB that have been provided by other CIMple components. The concept of this data base allows the results of all iterations to be administrated according to project, version and planning stages. Thus it will be possible to continually document the consultancy results during the entire life dycle of the CIM application in a given company.

WORKSHEET is CIMple's graphic desktop and in terms of its functionality can be compared to the graphic command console at the interface of production planning and control.

Corresponding to the process of production planning WORKSHEET offers functions for the planning of the CIM implementation with CIMple tools. Each CIMple user (CIM consultant, supplier or user) will be able to create several PROJECTS and define for each project VERSIONS and PHASES depending on the planning progress. These structures will be transmitted to the global data base CIMple DB in order for the results of the program executions to be stored with the correct project, version or phase identification. The user will be able to retrieve all corresponding results by declaring the project, version and phase identification. It is therefore possible to reconstruct the decision process at any given time during the life cycle of the CIM application.

Corresponding to the process of production control WORKSHEET offers functions for the control of CIMple tools during the planning process. If during a certain project phase a tool will be activated to perform certain planning stages, WORKSHEET ensures that the requirements for the execution of this program (e.g. availability of necessary input data that have to be provided by another program etc.) have been met.

Corresponding to the collection of company data WORKSHEET offers a logbook-function which automatically stores the application duration of each CIMple tool according to user and project.

3.3.1 Company Specifier (CS)

This tool is used at the beginning of the planning process for the identification of the company profile. The method of profile identification is based on the assumption that most SMEs can be divided into 8 basic profiles and related mixed profiles. For the identification of the company profile the following typological characteristics are being used:

- company goals
- product and production type characterized by:
- range of production (product type according to client specification, standardized product etc.)
    - production type (one of a kind production, serial production etc.)
    - order type (production for stock etc.)
- sales / marketing strategy

The profile will be developed in an interview with the help of a formal decision pattern.

For every question the user can choose from several answers. The next question depends on the choice of the previous answer. This method will be followed until an entire path in the decision diagram has been completed. After each entry the program will examine the reliability of the chosen answer. If an unreliable answer has been chosen, e.g. because there are evidently contradictions with previous answers, it is possible to select a different answer or even to retrace several steps in the diagram.

At the end of the interview a specific profile will be identified which will either correspond 100 % to one of the 8 types or which will be a combination of up to 3 types.

For every profile a list of evaluated CIM requirements will be developed as a recommendation for the next planning stages.

Evaluation scale

Absolutely necessary	***
Probably necessary	**
Possibly necessary	*
Not necessary	empty

3.3.2 Objectives Editor & Rater (OBER)

Starting with the company profile developed by CS in the first planning stage, OBER develops a priority list of the most important company objectives. The following method is used for this purpose:

CS provides an unevaluated list of typical company objectives for the identified company type. This list will be submitted to the management for evaluation. Every member of the management may cross off goals or add new goals respectively. Furthermore he evaluates every goal according to a scale from 1 to 10 and assigns every evaluation a reliability factor in order to estimate the reliability of his specifications.

A complete list of the primary company goals developed from those single lists will be relevant for subsequent planning stages.

The program OBER mainly consists of the two components Editor and Rater.

The EDITOR is able to delete, change or supplement company objectives. With the help of the EDITOR every member of the management can draw up his own priority list supplied with reliability factors.

Using the final results the RATER develops a complete list. For calculating the value of each company objective from the specifications made by all the members of the management RATER uses an equation which considers all evaluations and reliability factors. It is also possible, of course, to review not only this general list, but also the objective specifications made by each member of the management as well as the deviations. In case the management does not agree with the developed priority list it is of course possible to repeat one or more iteration stages of the process until the result is acceptable.

The next planning step of FTM is the specification of the CIM requirements using CDS. In case further company goal analysis and company data modelling are necessary it is also possible to leave the FTM path at this point and carry out those steps using CIMple's CRIMP and MMT tools and subsequently continue the specification of the CIM requirements with CDS. Whether it makes sense to take this course which implies more planning effort than the FTM - path has to be decided for each case individually. The most important criteria for this decision are:

- certainty concerning the company objectives

If there are uncertainties concerning the company objectives, especially in the view of future trends in technology, market and finances.

- complexity of the company structure

If the previous planning stages make necessary the development of a company data model incorporating the construction and work organisation.

3.3.3 CIM Detail Specifier (CDS)

The planning stage for the specification of the CIM requirements uses as its starting point:

1. A directory with generated CIM objects.

CIM objects are:

- CIM function area (e.g. CAPM, CAD, ACCOUNTING)
- CIM function (e.g. STOCK CONTROL, MRP, SFD)
- CIM element (e.g. ABC ANALYSIS, HISTORY)

A CIM function area can consist of several CIM functions; a CIM function can be composed of several CIM elements.

Each CIM object can be quantified and qualified by one or more ATTRIBUTES. COLOUR, LENGTH, NUMBER etc. are attributes.

The following informations are identified through the specification process:

- inclusion of a CIM object X into the list of requirements
- is mandatory
- must be excluded or
- is optional
- attribute values for every included CIM object if it has any attributes
- evaluation on a scale 0 to 5 for every included object.

This evaluation will later play an important role in determining the quality of performance of the available CIM solutions in comparison with the specified requirements.

A CIM object data base has been developed within the CIMple project. This data base is not complete, however. There are several gaps which will have to be filled in the future.

2. The list of CIM requirements evaluated by CS

These requirements and their evaluations respectively will simply be regarded as

recommendations in specifying CIM objects.

3. The priority list of the company's objectives (with or without the Rigorous Modelling)

This list will help to make a decision regarding the specification of CIM objects

CDS basically consists of the following functions:

1. Edit Objects - for the development and modification of a CIM object data base.
2. Edit Rules - for the development and modification of (horizontal) relations between different CIM objects of the CIM object data base.
3. Specify - for the development and modification of CIM requirement specifications using the CIM object data base.

The specification is carried out in the following steps after calling the function Specify, which provides a mask displaying the data of the CIM object that had last been worked on:

1. Selection of the object to be specified by <page browsing> in the data base
2. Selection of either <Include> or <Exclude> depending on whether the CIM object is to be entered as "required" or "to be excluded". The default <Don't Care> does not have to be changed if it is not possible to make a final decision at this point.
3. After selecting <Include> attributes are entered, provided the object possesses attributes
4. Evaluation of the object on a scale between 0 (default) and 5 (highest possible evaluation)
5. Entry of the reasons for deciding on steps 2, 3 and 4 into the field "notes".

If an object is excluded by selecting the <Exclude> switch, all other objects that are hierarchically subordinated to this excluded object will also be entered as <excluded>.

If object A is related to object B as <incompatible> (CANNOT BE USED WITH), object B will be entered as <Excluded> when object A is chosen.

3.3.4 Template Assembly Module (TAM)

The CIM specifications developed in the previous planning stage will now be processed in order to convert them into natural language.

- The requirements will be listed according to their hierarchical position in the CIM object data base
- The selected options (<Include>, <Exclude>, or <Don't care>) as well as the evaluation of every object will be displayed.

The requirements are described in the invitation for tender in this way to ensure that the suppliers use the same "pattern" in describing their own product. Since in this case their description will be consistent with the structure of the CIM object data base, it can be stored in a supplier object data base that has the same structure as the CIM object data base. The available solutions can then be evaluated by comparing the previously developed specifications to the supplier data. This evaluation constitutes the next and last planning stage in the FTM path.

3.3.5 Vendor Solution Creation Module (VS)

During this preliminarily last planning stage of the FTM path the objects that have been specified by CDS will be compared to all the supplier's solutions stored in the supplier object data base. Each solution suggested by any one supplier will be given a complete evaluation; the following individual evaluations are being considered:

1. The amount of matches considering the options chosen in the specification process.
2. The amount of mismatches also considering the options chosen in the specification process.

The software program VS (Vendor Solution Creation Module) displays the results in graphic and tabular form.

4. Extended analysis with CRM

In case the results rendered by the FTM analysis are not sufficient CRM can be used in addition for an extended analysis. In this process the data collected in OBER will be made dynamic in terms of their time limits. This can be accomplished by either using existing data or estimations. Using the developed target variables the program will calculate and show the company's current and future situation in a business as usual mode of operation. The modelling tools CRIMP (Cross Impact Modelling) and MMT (Manufacturing Modelling Tool) are being used to achieve this end.

CRIMP looks at the company from a bird's eye view and models it by defining how the different target variables (trends) interact The individual objectives selected with the help of OBER will be included in CRIMP as target variables.

On this basis various scenarios will be developed showing possible directions of the company's future development. The company's different strategies will be taken into consideration as well as different technological, economical etc. conditions. This method will be described in detail later on. With the help of this method it is possible to simulate the strategies in question which are formulated as "activity" vectors in this process. By modifying or exchanging activity vectors (concepts) a satisfactory result will be achieved in the end. In order to determine this point the results are entered into the Configuration Auditor (CA) and are examined according to the target variables defined previously. If the results do not lie within an acceptable range of values the activity vector will be returned to CRIMP for further modification.

If the activity vector is satisfactory, it will be incorporated into MMT and a production model will be developed. By analysing the production functions using the SADT method (Structured Analysing and Development Techniques) and simultaneously analysing the functions of the CIM elements it is possible to examine the CIM elements with regard to their aptitude for the necessary production functions. If the CIM components sufficiently support the production functions the quantitative evaluation can be continued. For this purpose products or product groups affecting all relevant fields of production are being formed. The CIM team now is able to carry out a more detailed evaluation of the activity vector by having MMT calculate the effects of each activity on the production targets. Production process and duration vary depending on the use of alternative resources. Any change in costs or output, such as productions costs, production times, productivity rates and flexibility, can be calculated.

CA will then compare the results produced by MMT to the specified goals.

The company modelling and analysis serve as a profound basis, enable the CIM team to select the suitable CIM concept and document very well the decision making process. The CIM components developed in the beginning by the company specifier were of a generic nature. The newly developed CIM concept also contains general CIM elements but nonetheless is tailored more specifically to the needs of a specific company.

By now the CIM team has developed a rather specific CIM solution which serves as the starting point for the selection of available CIM software products. This is achieved with the help of Solution Workbench.

The CIM requirements specified with the use of CDS will now be compared to the CIM products contained in CIMple's CIM library with no regard to specific suppliers. Those products which meet the requirements form the neutral product solution. This solution will be used as a "pattern" in acquiring, evaluating and selecting CIM software products. The remaining CIM products will all fit more or less into the previously generated pattern.The CIM team is now able to set priorities and evaluate products. The best solution has been determined and the CIM team has achieved its goal. It is now possible to begin with the implementation.

If necessary the previously rough evaluation of the general CIM solution can now be supported by a more detailed evaluation using the newly acquired informations. The already existing models in CRIMP and MMT can be used for this purpose. Since CRIMP and MMT are CIMple's most important analysis tools we will following illustrate their mode of operation.

4.1 The Cross Impact Model (CRIMP)

As already explained CRIMP's first step consists of discussing the company's strategic goals according to CIMple's method. In this process variables are defined in order to measure the degree of achievement. Those variables together with their current values (As-Is-Values) form a static model of the company's present situation. In order to make this model dynamic and to be able to "play" with it rules are required describing the development in the course of time.

An interview with the management again constitutes the first step: "What kind of a development do you expect if no investments are made?". The "business as usual" scenario then has to be compared to a development that includes investments.

The second step in making the model dynamic is the definition of cross impacts between the model variables. For this purpose CRIMP creates the Cross Impact Matrix whose lines and columns are allocated to the target variables. The user enters the effect of variable x on variable y at the intersection of line x with column y, either reinforcing or weakening, and adds their intensity: e.g. weak reinforcement or mediocre weakening. In order to characterize those cross impacts the user selects different arrows: rising (reinforcing) or falling (weakening) in different sizes (strong, medium, weak).

After the estimations have been entered CRIMP is able to calculate the dynamic behavior of the model. For this purpose the change of the variables resulting from the cross impacts will be calculated step by step, from scene to scene.

After the model has been completed all possible investments will be incorporated into the model. For this purpose so-called activities are defined, which can be carried out at certain points during the analysis and which will influence the target variables.

Those activities can, for example, consist of the purchase of new machines, the employment or training of new personnel, of advertising campaigns, changes in the product range or of the closing down of production plants.

So called "events" constitute the second extention of the model. Not only the company itself becomes active, but also its competitors, clients and so forth: the company's environment might be subject to change. External changes of this kind can be incorporated into the model by using "events". Events may appear in one or more scenes and cannot be influenced by the company. Depending on the situation of the specific company different changes can be considered: changes in consumer behavior, of raw material prices and exchange rates or the development of new technologies and the appearance of new competitors. In this context one should look for changes which might be dangerous for the given company. While the activities provide the possibility to find the company's chances the events help to examine the company's risks.

All CRIMP components have now been defined and the simulation can be initiated. It is important to test the various strategies in several scenarios since often those strategies promising the highest degree of success also present the company with the largest amount of risks. The company has to decide how much risk it can take or how much profit it is willing to sacrifice for a higher degree of security.

4.2 The Manufacturing Modelling Tool (MMT)

While the Cross Impact Modelling Tool (CRIMP) provides a rather global evaluation of the CIM project in its corporate environment the Manufacturing Modelling Tool (MMT) makes possible the detailed planning and evaluation from the point of view of the production. Starting with the production targets defined in the CIMple tool OBER together with their target variables and "SHOULD BE" values it is possible to develop "WILL BE " values for the CIM solution by modelling with MMT. A WILL-BE solution is defined as several activities which span an investment program to be completed in several stages. An activity vector of this kind can either be transferred or an activity vector prechosen by CRIMP can be included. The more detailed the informations about CIM investments in the activity vector, the more accurate will be the results rendered by MMT.

The production structure planning and the production evaluation are based on the product structure. The analysis of the product structure and its activities for the production are carried out by the main module of MMT, the Product Modeller (PM). This module is supported by the Resource Specifier (RS) which makes possible the incorporation and specification of all resources necessary for the production according to their costs and capacity and which stores those informations in the CIMple data base. With this process effects of alternative CIM components on production can be evaluated in terms of their costs and output.

The analysis and evaluation of the product structure is carried out with the help of another module, the "Functional Area Specifier" (FAS). For the analysis of the product structure from a functional point of view the SADT method together with IDEF-0 software can be applied. After structuring production functions with the TOP Down method it is possible on the one hand to examine alternative CIM components with regard to their quality and functional suitability within the analysed production environment. On the other hand the functional areas of the structure model are entered as a "Workcenter" and costs and output of the production are assigned to these workcenters. The MMT results are cost and output parameters (e.g. run times or production costs), calculated according to the individual goal for the production. The calculated WILL BE values will be transferred to the Configuration Auditor, which determines the degree of achievement of every target variable and which carries out a general evaluation with regard to the already developed target evaluation.

5 Summary and Prospects

The advantage of the described method is that CIM investments are no longer viewed as a one dimensional problem. Instead of simply comparing costs and savings CIMple aims at developing a general view of the company and its environment.

The first step in this process is to understand and define the company's strategic goals. This is only possible if all those involved in the decision making process act concertedly; for this reason their participation in defining those goals is so important.

But in fact it will no do if this agreement is limited to the management. As experience has often shown the best solutions are of no use if they are not accepted by the employees as well. The future changes will be accepted most easily if all those affected are incorporated into the planning process early and if they have the possibility to influence the decision. As far as that goes CIMple's methods regarding the joint definition of goals in the first stage of the planning process can be seen only as a first step in attaining a higher degree of involvement and responsibility. In the subsequent stages the realization of those goals has to be discussed in the same way with the employees.

This requires, however, that all those affected can understand and possibly even experience the intended changes. Only those who understand their future role in the CIM environment will be able to contribute to the discussion and become involved. And those not informed and involved tend to view the innovations as dangerous and therefore reject them.

What is lacking therefore are improved models and simulation techniques that come close to reality. Just as there are flight simulators and driving simulators which enable the driver or pilot to get a feel-

ing for his tasks and by which means he can solve them, there ought to be CIM simulators. They would make it possible for the employee to experience his new work environment in a playful way and to learn how he will communicate with collegues, which field he will be responsible for, the way in which he will work with the new tools and so forth. In other words, we would like to have something like "Virtual Reality" for CIM systems.

But not only the simulation techniques for CIM systems have to be improved, the CIM systems themselves need to be further developed. Apart from the technical problems there are mainly problems concerning the employees and their qualifications. Unfortunately the slogan "Human Centered CIM" is far away from reality. This cannot be changed, however, by engineers and software specialists alone. What is required are interdisciplinary cooperation and, most of all, the cooperation of all those affected.

Finally there will be new problems for our companies connected with the expected requirements for ecological and recycling-oriented production methods. The growing need for international cooperation will also result in new challenges. Because of these and other not yet discernible developments new requirements will continually have to be met by CIM systems.

One has to assume, therefore, that the CIM implementation in a given company is a continuing process which will never reach a final conclusion. Accordingly there will always be the problem of developing and evaluating alternative solutions. And it will always be important to keep the general goals in mind and to keep an eye on long term targets.