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INFORMATION DEMANDS OF DESIGN MANAGERS IN AUTOMOTIVE INDUSTRY

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Abstract

This paper describes the specific information demands of design managers in automotive industry and presents a preliminary approach that addresses these needs. As a consequence of rising product complexity and functionality as well as exploding product variant numbers the amount of information that is necessary to be able to manage a product development project has further increased over the last years. It is one of the main challenge for design managers to access, document, process and distribute the essential information in a product development process. The work load of the employees in a product development environment is commonly extremely high. It is therefore nearly impossible to motivate designers and project managers to spend extra work for the sake of information management. In this paper an approach is presented which consists of two pragmatic straight-forward tools – the Project Monitor and the Information Platform. The approach combines as little expenditure as possible with high benefits for the company, but also for the design engineers themselves.

Keywords: information management, design management.

1. Scope

Several studies concerning the introduction of design methods in industrial practice [1],[2] highlight the importance of the specific product development environment for the application of these methods. Consequently, in this section the field of experience and application of the proposed approach is sketched. The main focus are mature product development processes with a certain deadline for serial production. Such processes are commonly referred to as *late stages* of a design when manufacturability and schedules play a major role. These processes are characterised by a large number of designers and manufacturing engineers, who have to cooperate and communicate over company borders in order to achieve the goal – the start of production of the product. Especially in this stage of a design large amounts of information have to be exchanged which have to be readily available, current and accurate. The approach takes the specific demands of this design stage into account. Tools for supporting early development stages and new product development may require different points of main emphasis. However, discussions with design engineers working in different product development environments and stages give rise to the supposition that the underlying premises are generally valid.

2. Background - information management

The presented work should be seen as a facet of the research area "information management". In this section the underlying concept of information management is briefly analysed in order to elucidate the position and point of main emphasis of the presented approach within this theoretical basis.

In order to understand the concept of information management it is helpful to take into account, on the one hand, the management cycle defining the notion "management" [3] and, on the other hand, the model of knowledge management [4], which represents the normative and strategic framework of information management (Figure 1).

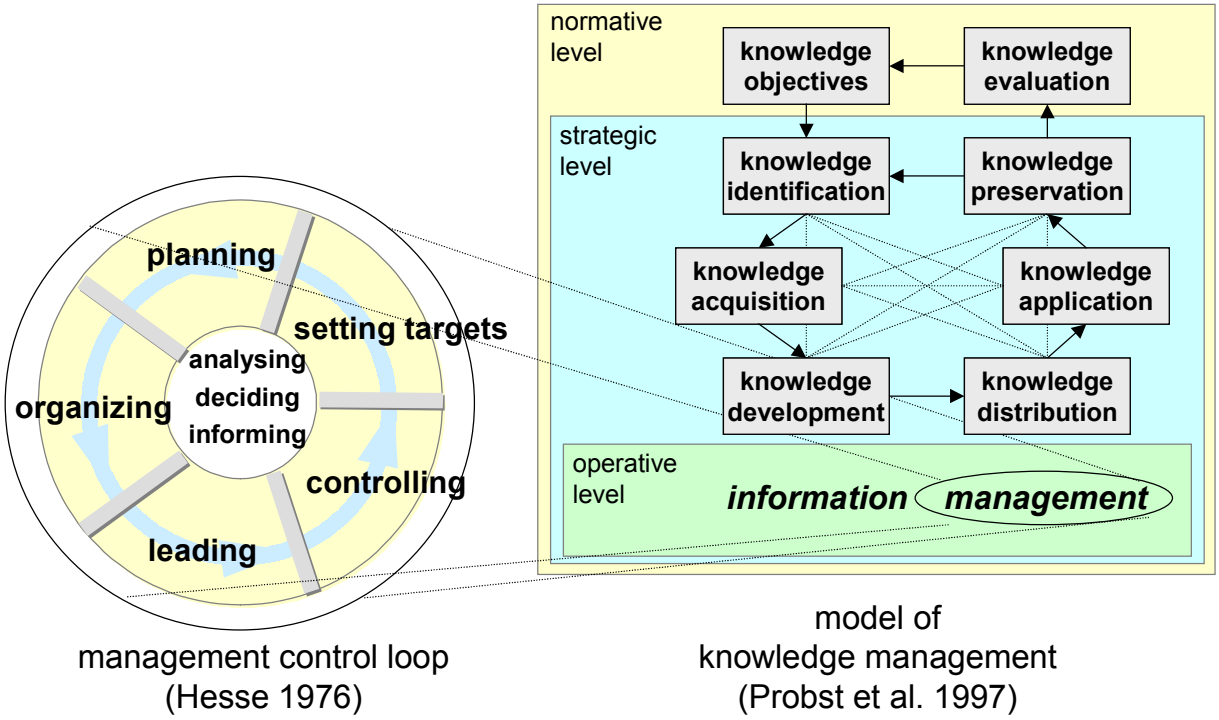

Figure 1. Information Management – meaning of the notion

In brief, information management is the cycle of setting targets, planning, organizing, leading and controlling of the production factor "information" which is the carrier of any knowledge. Information management is a necessary prerequisite for a knowledge management within a company. Without the conscious analysis and optimisation of the information flows within a company, all the expenditure for a knowledge management will not bear fruit [5]. Moreover, even a successful project management will not be possible without managing the sheer overwhelming flow of information.

Eckert, Clarkson & Stacey [6] underline the importance of managing information and state that information management in large-scale engineering design is difficult and challenging as a consequence of the diversity of channels (CAD information, text based information, direct communication), the scale of these projects, the variety of perspectives (different ways of thinking of the participating specialists), and uncertainty (designers need incompleteness and impressions to create new ideas). The presented work is based on the hypothesis that a certain limited body of essential information needs to be shared in an unambiguous manner in order to cover the project status and to allow a conscious process management. This body of information needs to be extracted from the different channels and needs to be presented in a predefined form which is familiar to all participants.

Carey, Vogel, Cagan & Weingart [7], [8] observed during a large-scale research project in automotive industry that different disciplines in a company will fall back on their own perspectives and will lose sight of the complete picture, if resources and pressures are pushed to their limits. In such situations an information basis for discussion and agreement is needed in order to achieve sensible joint decisions. It is a central hypothesis of this work that this information basis should consist of a limited body of essential information which is available,

agreed at by all participants and presented in a form that is understood by all participants of the product development process.

In the early stages of the presented project the target was set to manage essential information in a complex product development process of one of the most valuable modules of a car, the seating system. In the centre of the approach were the planning and organizing of information in a way that it could be used to be spread over the participants in a complex, distributed product development process. Therefore, the point of main emphasis of the presented work in terms of knowledge management was to establish the suitable information flows for the "knowledge distribution".

3. Information in design management

Obviously, the most important information in design management are data describing the product itself, i.e. its geometry and direct properties (material, …). Comprehensive work has covered this field and elaborate commercial solutions for the management of this type of information are available. The second major source for information is the product development process. Design managers need to be able to keep an overview over multiple process steps, problems, decisions and schedules, e.g. for the design of sub-modules, product tests or the production of tools.

This kind of information is characterized by its dynamic nature in terms of content as well as structure. Obviously, the information content of a product development process is ever changing when the design evolves. However, in real life product development processes in automotive industry (probably in most industries) also the structure of information is ever changing. In the design of sub-modules of a car major characteristics are changed and new features are added with any generation shift in order to keep up with rising competition. The changes alter the product structure, the manufacturing processes and the course of the product development process. Unfortunately, these alterations differ from one process to another and cannot be foreseen at the beginning of the process. Consequently, any approach that intends to arrange information according to any unalterable structure, e. g. predetermined product structures or process charts, is only of limited value for design managers.

A further important characteristic of process information is that process information is frequently ambiguous. For instance, decision are very often not expressed clearly or are accompanied by exclusions or further conditions. Also test results frequently do not give a simple yes-no answer, but require consideration and interpretation. Usually everyday design work is anything but a pure algorithm. In any support system design managers need to be able to interpret, supplement and comment information.

In contrast to product information, process information usually require context to be meaningful. An elaborate engineering drawing might enable any supplier to produce certain products, but even a very detailed process chart in general will not enable other companies to execute the same process. As a consequence, any effective design management support system must allow multiple links to contextual information.

In today's automotive industry sub-modules, such as car seats, are developed in networks of system suppliers, sub-suppliers, tool manufacturers, test labs, consultants and engineering service providers. At each "point" of this network information is generated or, even more important, altered. A system serving the information demands of design managers must

enable all participants of the product development to add or alter (directly or indirectly) the information content or structure as easy and rapidly as possible.

In brief, any support of design managers has to take into account the specific characteristics of process information, i.e., its dynamic nature even in terms of structure, its ambiguity, its meaningless without context and its distribution.

4. Corner-stones and elements of the presented approach

In the last sections the nature of information in design management was summarized in order to elucidate the main focus of the presented approach. Another important characteristic of the approach is a pragmatic, straight-forward proceeding. Extensive studies [2], [9] have shown that methods and tools will only be used to their full extend, if they can be flexibly adapted to the needs and preferences of the user, if they are easy to use, and if the user is rewarded with immediate benefits.

During the course of the project a set of tools that represent a comprehensive project status called Project Monitor was generated. In this tool the most relevant information is extracted from a number of sources and is represented in an unambiguous standard form. The Project Monitor is described in detail in section 5. It became obvious that such a Project Monitor can only be utilized to its full extend, if the information can be distributed throughout the project. Therefore a second instrument, called Information Platform was developed. The Information Platform allows all participants in an development project to access and supplement the current project status. The Information Platform is described in detail in section 6. Figure 2 gives an overview over the corner-stones and elements of the presented approach.

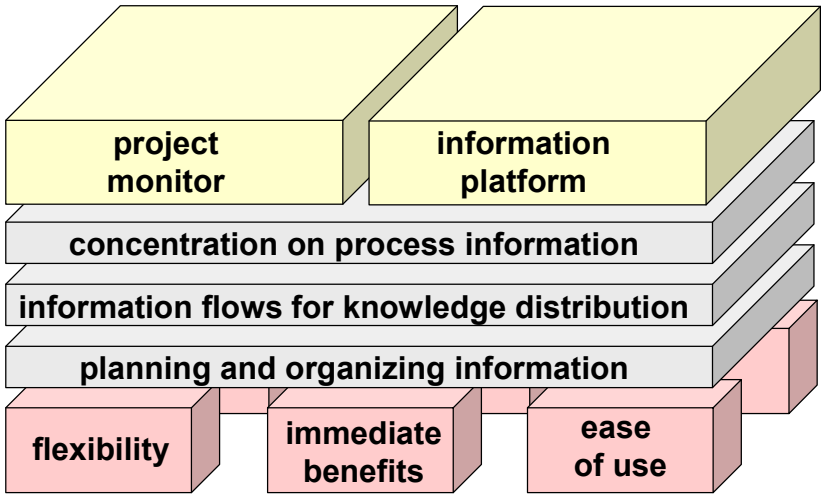

Figure 2. Corner-stones and elements of the presented approach.

The presented approach concentrates on two pragmatic straight-forward tools for improving the information flow within a complex product development process. Obviously such tools can only be successful if a strategic and methodical framework for integrated product development is established. In order to focus on information management, the diversity of elaborate method and tools for product development process planning and controlling [10], [11] is not the discussed in this paper.

5. Project Monitor

One central element of this approach is the Project Monitor which contains all the relevant information for a technical controlling and for management, i. e., the project status and the technical maturity of the project or of the product, respectively. In a simplified sense, the Project Monitor allows to assess how far a project has advanced. The approach is build on the work of Seng, Knapp & Hofmann [12], who created the idea of the so called "Project Monitoring" in order to create transparency within a project. Their project monitor is a pragmatic but comprehensive tool supporting project management by holding all relevant data. This tool was originally based on paper (on a planning table), and then transferred to a computer supported tool.

Independent to the form of implementation, a set of general requirements, which are to be fulfilled by the project monitoring system and additionally characterize this system, can be defined. Some of the main aspects are:

- transparency of the current project status
- availability of all relevant information of the project
- consistent and high quality project data (current, definite, complete, not redundant, true, and trustful)
- possibilities for condensation and analysis of the data for decision support on superior organizational levels
- support for realizing discrepancies and changes, target/actual comparisons, identification of critical elements, derivation and estimation of measures
- quick access and ease of use, especially for distributed development processes
- continuous use throughout the whole project/process, adaptability and connection to other projects or divisions
- no definite workflow guidance through the project
- flexibility for changes within the project
- creating a standard for the information acquisition, processing, and transfer, for example by means of forms; minimal in order to be flexible, maximal in order to optimise exchange
- continuously accessible project status of any date (review, current, prognosis)
- regarding product variants and supporting general configuration management
- personal orientation concerning responsibilities, preparation, and distribution

The previous listing showed the requirements to the project monitoring system in general. On this basis a Project Monitor for the management of the product development of a car seating system was generated with a special emphasis of large-scale distributed product development processes [13], [14]. The most simple and straight forward approach to address the need for flexible structures in such processes is to allow anyone to perceive, establish and alter information structures. In a product development network it is nearly impossible to teach every participant the use of specific tools for capturing process information, because the participants have different education levels and work in different locations, organisations and even companies. As a consequence, commercial spreadsheets such as Microsoft Excel are currently the most promising way to capture dynamic process information. These programs

commonly allow to supplement entries with explanations and interpretations in order to cope with ambiguity. Additionally, these programs enable links to further contextual information.

However, it is not sensible to start with blank spreadsheets in any product development process. Therefore a standard set of files which contain the most important process information was developed and matured over the course of several product development processes. Still these predetermined structures can be (and are) altered during the product development process. This standard set, which is the core of the Project Monitor, consist of the following spreadsheets (Figure 3):

- Follow up chart:
  In this chart every product part is listed together with the most important dates and milestones for this product part (project phases, product models, tools, engineering releases, and quality releases. For every product part a traffic light, similar to workflow planning with "signposting" [15], as an estimation of the status is given.
- Decision status:
  In this spreadsheet all relevant decisions which are made in the different committees that steer the project are listed together with the date of the decision in order to keep track of the current targets and in order to identify decisions which are outdated or contradict each other.
- Complexity/variant chart:
  in this chart the variant tree of the product (subassemblies and component variants) is represented in an simplified, easy readable form.
- Potentials and risks list:
  In this spreadsheet prominent potentials and risks (such as the outcome of tests that only can be performed with sufficient precision with serial parts close to the release date) are listed and their potential effect is assessed qualitatively and quantitatively.
- Weight list:
  In this list the weight of all product parts and their variants is represented in order to keep track of the overall weight of the seating system which is a major issue in modern car industry.
- Cost list:
  In this list direct costs, tool costs, material costs, production costs, special charges, development costs, investment costs are included.
- Technical description:
  This textual description of the product is in some sense redundant to the product information managed in the CAD, DMU and PDM systems, but is easier accessible and contains only the information (of hundreds of CAD models) which is most important for design management. The product and its functions and elements are described in an abstract, very brief but concise form. The document is focused on technical functions, legal constraints, as well as comfort, industrial design, quality, and safety issues.
- Problems list:
  This list is build up like a familiar "to do list" and contains problems in the project course together with activities to overcome these problems, the dates for these activities and the responsible persons.
- Testing status
  In this chart tests and inspections according to the engineering and quality specifications are listed with date, result, relevance, and an assessed risk for changes.

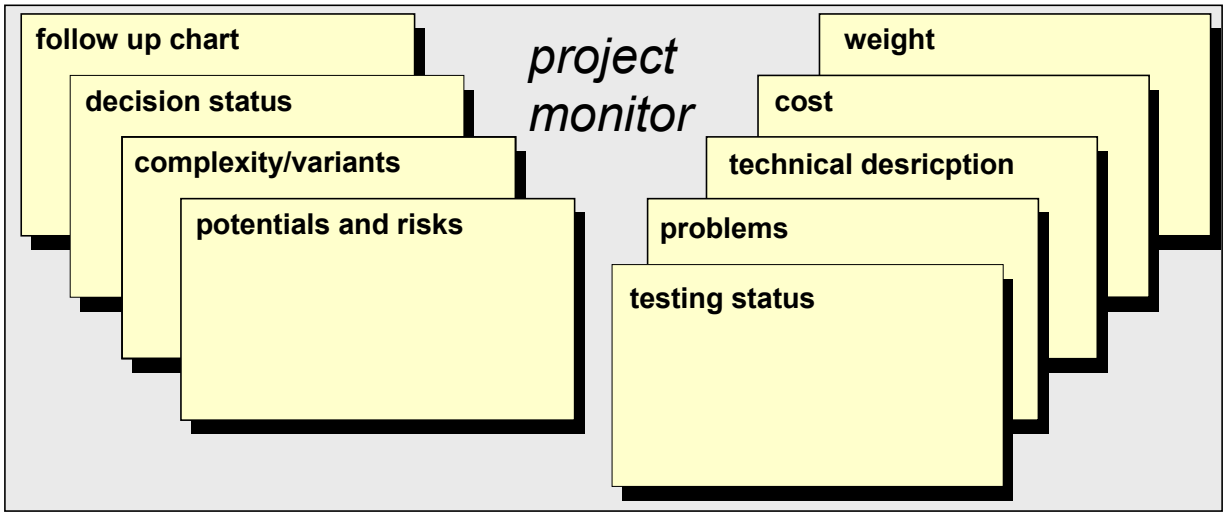

Figure 3. Project Monitor

6. Information Platform

An important challenge of today's product development processes is the fact that they happen at different locations or even companies, i. e., the distribution of the product development processes. A set of files containing process information such as the Project Monitor is only useful to their full extend, if these files are easily accessible by all process participants, if the information is current and accurate, if redundancies are avoided and if the expenditure to extract or enter information is very small. These objectives can only be achieved, if every participant is able to access a common file server. In automotive industry a specific network (ENX) can be used for this purpose. A prototype was realized (based on the user administration of a commercial EDM-System) and first results are promising. It is important to note that a high performance of the system and a straight-forward user administration are basic prerequisites for an acceptance of such a system.

In the Information Platform a current project status in form of the set of spreadsheets called Project Monitor is made available to different participants of the product development process:

- the members of the project team at AUDI, the original equipment manufacturer
- the members of the project team of the system supplier of the seating system
- the project managers of component and parts supplier of the seating system

Special rights and duties are assigned to the participants of the project. The members of the project team of the OEM and the system supplier are required to read the information contained in the Information Platform periodically, to fill in all relevant information and to keep the charts and lists current. The part or component suppliers are required to keep themselves informed about the project status.

Figure 4 gives an overview of the Information Platform.

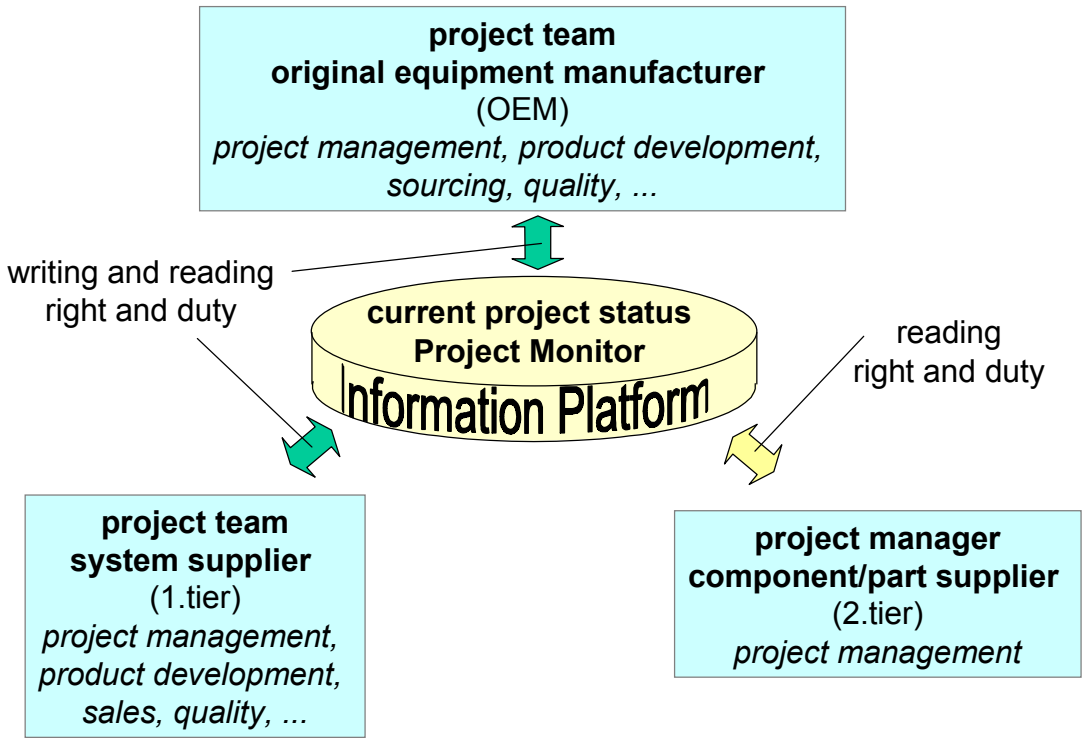

Figure 4. Information Platform

7. Example and preliminary results

In this section the follow up chart which lists every product part together with the respective most important dates and milestones is explained in more detail. Two sample lines of the chart, which is one of the main elements of the presented approach, are shown in Figure 5.

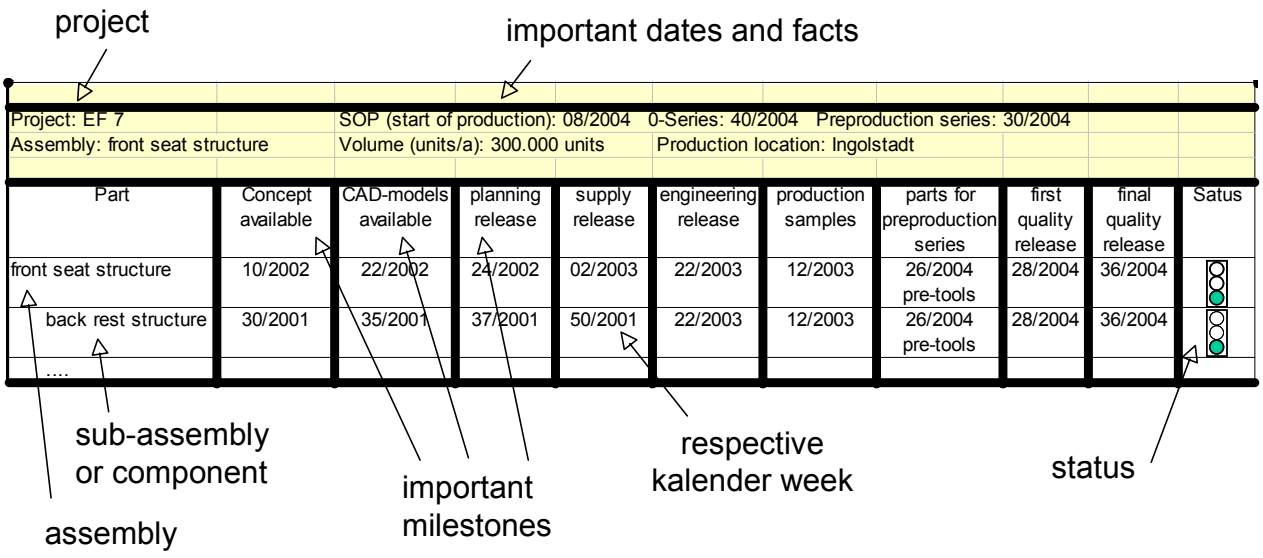

Figure 5. Follow-up chart: sample lines and explanation

The follow-up chart is intended to be used as a high-level instrument throughout every product development project. In the top part the most important data of the project are given. In this chart for every product assembly, sub-assembly or component important milestones are connected with planned or actual dates. Additionally a traffic light as an estimation of the status is given. The main advantage of the follow-up chart is the condensed information which concerns all the different departments participating in a product development process. In this instance, this chart is a good example for a pragmatic, straight-forward tool for information management which contents can be understood by participants in different departments and disciplines.

The presented tools are right now used in two large-scale seating systems product development processes and were used in another two projects which already led to successful products. The quantitative impact of tools to a product development project cannot directly be determined [2]. However, the opinion of the participants in the respective product development process indicates clearly that the two pragmatic tools had a strong positive impact on the project success. Future work with the current refined versions of the tools will be closely observed in order to be able to assess the effect more precisely.

8. Conclusion

In this paper the specific information demands of design managers in the later phases of large-scale product development processes were analysed and a straight-forward approach to cope with this demands was presented. The focus was the organization and distribution of information in a complex product development environment that spreads over space and time and even over company boundaries. This approach, built up by its elements Project Monitor and Information Platform, is a combination of spreadsheet files, intensively suited to the specific product and process but still alterable, and a common access area with specific user rights and duties. It is an approach to overcome some of the causes of the manifestations of information breakdown as listed by Eckert, Clarkson & Stacey [6] such as a lack of awareness of tasks that need to be done. Obviously, the presented approach is preliminary and very pragmatic. Intensive work of research together with industrial practice is encouraged to cope with the specific characteristics of product development process information.

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