

Development and Validation of an Information Demand Pattern for a Team in Project Management

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Abstract. Organizations are faced today with an increasing amount of information. This information overload leads more and more to wrong decisions and has therefore economic consequences. Especially decision-makers and knowledge intensive workers are affected. This work introduces information demand pattern for teams in order to improve the information flow in the knowledge intensive field of project management. The contributions of this work are (1) the methodological description how to develop information demand pattern for teams, (2) the presentation of an information demand pattern for a steering committee in the context of project management and (3) general advises on information demand pattern and information demand analysis.

Keywords: Information Logistics, Information Demand Analysis, Information Demand Pattern, Project Management

1 Introduction

Every day a lot of information is produced. This volume has greatly increased in recent years. Society has changed to an information society, where the availability of information cannot be viewed anymore as an obstacle for a demand-oriented information supply, but finding the information by the person who needs them. This development does not stop in front of organizations, so that they are faced with an ever-growing amount of information as studies have shown [1]. Information overload has demonstrated a high topicality as current studies showed [2].

Contrary to previous assumptions, as information was a rare good that more information is equivalent to an improvement of problem solving and decision-making, today the opposite effects can be observed. Thus, the amount of information is an increasing problem in today's information society [3]. Locating relevant information turns out to be difficult and consequently the requirements grow for a suitable structuring and a tailored access [4].

Information logistics as an application field of business information systems deals with this problem and has the goal to achieve an improvement of the information flow in organizations by providing a demand-oriented information supply. Information logistics offers methods, concepts and tools to achieve an improvement. Under the concept of demand-oriented information supply the right information at the right time, in the right quality, in the right form and at the right place for the seeking person is understood [5].

In order to improve the information flow inside companies information demand patterns (IDPs) were developed [6]. These cover the information demands of a single role represented by a person within an organization to identify repeatedly required information for this role. As with patterns in other disciplines of computer science, these patterns have the purpose to detect a proven solution to a problem in order to reuse it in other application scenarios. With information demand patterns, the identified organizational knowledge is collected in a structured and reusable way that enables to support the targeted role and counteract a flood of information. Overall, the efficiency of information provision should be improved, thus work processes can be effectively designed and carried out. Furthermore the time required for finding the relevant information can be reduced. For the same role in different application contexts it should be possible, to provide the needed information on time, in quality and in the accuracy required as proposed by the definition of information logistics [6].

In the corporate environment works are often characterized by teamwork in projects involving several participating roles. In the course of projects, which are characterized by new tasks and routine procedures, there may be problems related to information supply for each role in many ways. Thus, the already mentioned problem of information overload is a problem, since much time is used for finding relevant information. On the other hand, a shortage of information is not a solution, since it obviously leads to absence of the required information, which in turn affects the work in a negative way [4].

Concerning teamwork the same questions apply with regard to the collection of information demands and the development of a generic solution for detection. A pattern, which now describes the information demands of a whole team can help to improve structures and processes within the team and to generally increase the efficiency in the team, as it is developed on an aggregate level and has a holistic perspective on the team. In the context of this paper, such a pattern is presented.

The contributions of this work are: (1) the development and validation of an information demand pattern for a team (2) a methodological approach to develop this kind of pattern and (3) general advises on information demand patterns and information demand analysis.

The work is structured as follows: section 2 describes useful background information concerning information demand analysis, information demand patterns and project management. Then, the development of the pattern is shown in section 3. The following section 4 presents the validation of the pattern. Conclusions and an outlook are given in section 5.

2 Background

Information demand analysis is a precondition for constructing an information demand pattern. Although the approach of Sandkuhl to develop an information demand pattern [6] strongly relates to the information demand analysis method by Lundqvist [7], we examined different methods of information demand analysis as well as areas of research in this field. Strauch and Winter describe a detailed approach on information demand analysis concerning data warehouses. Starting with a target group analysis the analysis leads to an information map, which will be transformed into a cube-structure

model regarding several self-selected dimensions [8]. Cappiello and Comuzzi focused on an approach to define the optimal quality of information provided from an IT Service. In order to completely satisfy users demand as well as the provider's organizational requirements [9]. Further approaches optimize the process of finding the information need with aggregating heterogeneous information sources and presenting the results to a user in a personalized manner [10].

Due to a better understanding of the following work, this section introduces briefly some key principles concerning information demand analysis, information demand pattern and project management.

2.1 Information Demand Analysis

Information demand analysis addresses the systematic collection of information demand [4]. The information demand is identified and analyzed according to a method introduced by Lundqvist by using interconnected phases, which are performed sequentially. The phases are listed below and their contents are briefly described [11].

- **Scoping:** In the first phase, the area of analysis is set. Here, the part of an organization with regard to the information demands is selected and people who provide the necessary information during further analysis activities are identified. The customers' problems are considered as well, so that they are motivated to carry out the analysis. In this context, responding to intentions, goals and expectations of customers are considered as well.
- **Information Demand Context Modeling:** Then the basic information demands, recognized within a defined range, were identified. For this purpose, the relationships between roles, tasks, resources and information have to be considered. It is assumed that all people with the same role have the same information demand for a specific task. This correlates to the role-centric perspective.
- **ID-Context Analysis and Evaluation:** In the third phase, the collected information for the context will be analyzed and presented in a suitable format for further work, this information will be further classified and refined and linked to maybe already existing information demand patterns in the company.
- **Representation and Documentation:** Finally, the previously created models and documents, which are in different notations, are summarized and transferred into a consistent and coherent presentation form. This involves a continuous and iterative process until the goal of the analysis is achieved.

Lundqvist has shown in a study in companies that the information demand of an employee depends on the role in the organization that he or she fulfills. The structured collection of this information, which is necessary for the processing of work tasks, was underpinned by the development of a methodology for information demand analysis and validated [7].

2.2 Information Demand Pattern

After detecting the information demands of a role in a company, Sandkuhl presented the concept of information demand pattern. As with patterns in other disciplines of computer science, these patterns have the purpose to detect a proven solution to a problem in order to reuse it in other application scenarios. With information demand patterns, the identified organizational knowledge is collected in a structured and reusable way. The term information demand pattern is defined as follows according to [6]:

An information demand pattern addresses a recurring information flow problem that arises for specific roles and work situations in an enterprise, and presents a conceptual solution to it.

Information demand pattern consist of five integral components: *Name of the pattern, Organizational context, Problems, Conceptual solution and Effects.*

The **name** is used to identify the pattern. This is usually the name of the role, which the pattern describes.

The **organizational context** explains the application context in which the pattern can be used. This can be departments, functions or domains.

Problems represent the difficulties and challenges that the person is facing in filling their role in the company. Also duties and responsibilities of the role are subsumed under this point.

How the described problems of the role can be solved is shown in **conceptual solution**. It is divided into three areas, *information demand, quality criteria and timeline*. Information demand describes the information that is necessary to fulfill the duties and responsibilities of the role. The quality criteria describe the quality in which the information must be available such as the general importance of the accuracy, the time and the completeness of the information. The timeline represents the time at which the required information must be available at the latest.

The **effects** part describes effects that may occur if the information is not available or not in time. The possible effects occurring may be associated with the following dimensions: economic effects, time and efficiency, quality of work, motivation, learning and experience and customer [6].

The concept of information demand pattern has been studied in several other works and its applicability has been validated [12-14].

2.3 Project Management

According to DIN 69901, a project is characterized by uniqueness of the conditions, such as targets, temporal, financial, personal or other limitations and the project-specific organization [15, 16]. According to this definition, a project is characterized by a different approach from the daily work, which is structured and performed separately from the actual organizational structure. Other features here are the time limitation and the limited resources.

Furthermore, the project management is defined as "the totality of leadership, organization, techniques and agents for the initiation, definition, control and completion of projects " [15, 16].

Similarly, the project management is defined in several standards for project management. Standards for project management include the previously presented

concepts and structures and try to create a unified understanding of the concept beyond so that further aspects, such as roles, processes and methods can be described [17].

Some standards have gained international importance and are used in many companies. These include in particular the Project Management Body of Knowledge (PMBOK), Projects in a controlled environment (PRINCE2) and the IPMA Competence Baseline (ICB) of the International Project Management Association [18].

These are also for the further course of particular importance, as they form the basis for the development of the information demand pattern for teams.

For the project management dividing the project into phases is a way of planning and control in order to reduce complexity.

Project phases are sections in a project where additional control is needed to effectively manage the completion. Project phases are typically completed sequentially, but can in some project situations overlap [19].

The DIN differs between project management phases and project phases. In this sense, the project phases are special sections that are adapted to the activities in an organization. The project management phases are based on the segmentation of the general activities in project management. For this, a classification into five phases is done: initialization, definition, planning, management and completion [15, 16].

3 From Single Pattern to Team Pattern

In this section the development of the proposed information demand pattern for a team is described. The resulting identified information demands should lead to better information supply to the team. The base of the information demand pattern for a team, hereinafter called team pattern, form the information demand patterns for each role on this team. These patterns for single roles are further in called single pattern.

3.1 Methodical Approach

For the development of information demand pattern in general and for specific organizational roles Sandkuhl presented a method [6]. The method describes an iterative multi-step process, which is used to develop our team pattern and shown in figure 1.

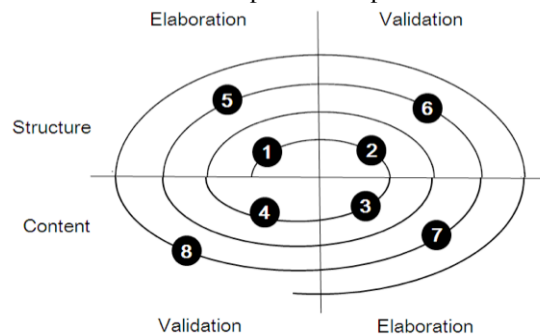


Fig. 1. Iterative process of elaboration and validation of information demand patterns [6].

The first steps (1-4) represent the first iteration of the method, which is characterized by the participation of the research team in the development only. In the first step the initial structure of the pattern is noted. In the second step suitability is checked for the description of information demands an organizational role. The structure is checked for internal consistency and correctness also. The third step involves the selection of a simple, but sufficiently complex organizational role and develops the content for the selected role. Then these in the fourth step are validated by the internal consistency and completeness is checked.

The second iteration includes the development and validation of an engage with actors beyond the research team and the science into consideration. It begins with the fifth step in a further elaboration of structure based from experience regarding the development and validation of the initial pattern (step 3 and 4). Improvements concerning the structure and the pattern are described in the following sixth step. The validation of the improved version involves now more actors as well.

The following iteration steps after the eighth step contain further elaboration and validation activities that involve participation of stakeholders outside of the research team and the science [6].

Due to a literature analysis of the standard project management literature described in section 2.3 there were four roles identified, which form the body of a steering committee according to PMBOK, PRINCE2 and ICB. These are: project manager, project sponsor, customer representatives and supplier representatives. For each role, then a single information demand pattern is developed. For this purpose, the standard literature for project management is searched for duties and responsibilities of these roles.

After this first substantive elaboration, a check is investigated whether the information demand patterns are consistent and complete. For this purpose, the information from the literature is further researched, and the pattern with the experience gained on consistency and completeness are checked. The identified improvements are hereby incorporated into the information demand pattern.

Based on the improved information demand patterns, a validation is performed in the form of semi-structured interviews with representatives of the considered roles. This includes representatives from the governing body of a university project for system development.

During the interviews, respondents are first asked openly to their duties, responsibilities and the resulting information demands. This was done without given predefined response options to recognize and include new aspects. After the open survey it was explicitly asked for answers to specifically examine the data in the literature on their practical relevance and to check the further investigation of information demands with respect to the meaning of the individual information and the impact of not or not timely received information.

From the validated information demand patterns for every single role of the steering committee, a generally applicable information demand pattern for teams is developed, covering the team as a whole. From the information demand patterns for the team, all components of the individual roles can be derived. In addition, the team contains pattern elements that are relevant for the team as a whole. The information demand patterns of each role are validated through the semi-structured interviews.

3.2 Information Demand Pattern for a Team

In the following the team pattern will be presented briefly due to space limitations. The team pattern is structured according to the structure of single information demand pattern shown in section 2.

The **context** of this IDP is a team pattern for the steering committee of a project in an organization. The scope is the field of project management and refers to large and medium organizations although it can also be applied to small enterprises as well.

The project management deals with the planning, delegation, monitoring and control of all aspects of a project, as well as the motivation of all those involved, with the objective of achieving the project outcome within the expected performance targets in terms of time, cost, quality, scope, benefits and risks [20]. The steering committee is responsible for the success of the project and it takes on the direction and control of the project within its area of responsibility [20]. It consists of an executive (i.e. the chairman of the project board), a project manager, a user, and a supplier representative [20].

The steering committee serves as a spokesperson for higher levels of management and represents the interests of the project to get support for the project and to sponsor the project. In addition, the project board is responsible for the communication with the stakeholders outside the team. Within the scope of the provisions of the corporate management or program management, the steering committee takes over the overall responsibility and authority for the project. Furthermore, it is responsible for the provision of the financial resources and payments in kind [19].

The **problems** and the fields of activity with which the steering committee is confronted are versatile and have their causes in both project internals and externals and can affect all project aspects, because the steering committee takes the responsibility for the result of the project. Moreover, it is dependent on information about the current progress of the project, as well as problems and risks, which both have appeared during the project. Information about the project progress contains further information so that it should be exactly determined which information is provided to the steering committee and under what prerequisites, so that decisions can be taken contemporarily and the frequency of the meetings, so that the coordination efforts remain in an acceptable frame.

If any of the required information is not available to the steering committee, there is a risk that it cannot decide in an appropriate manner how the project will continue. Thus, related measures may not be planned and implemented appropriately.

In addition, if the steering committee does not receive information about all essential project aspects or not on time, problems with the coordination and regulation in the project can occur. The consequences of the mentioned problems and risks can have serious effects on the organization, which can lead to economic consequences and image damage [6].

Next, the **conceptual solution** of the pattern with the information demand, which is based on the tasks, and responsibilities of the team, follows. The steering committee takes the responsibility for the success of the project. It consequently takes over many different tasks and responsibilities. In principle, the steering committee is responsible for the project in its entirety and takes over its leadership. The project board is not only supposed to represent the project, but also the stakeholders and promote the whole project [19]. In addition, it shall guarantee a uniform and effective decision-making [18].

Furthermore, it is responsible for providing the required resources for the project [21]. To sum up, it takes over planning, control, coordination, monitoring, and support tasks.

The general areas of the **information demand** of the steering committee cover legal, organizational and technical frame conditions, as well as information about changes in these frame conditions.

Besides that, some fundamental information about the project is needed. This information regards the aim and size of the project and is needed in order to let the project board decide on the approval or rejection of the project. At the end of every project phase, once again the steering committee checks whether the project will be continued or stopped if it is economically no longer profitable.

Generally, the information demand of the steering committee can be categorized into the following four areas: Business environment, Project specification, Project progress and Project close-out.

Quality criteria are summarized in figure 2 with the information demands (left column), the general importance of the information, its accuracy, time aspects as well as completeness. In the following, a part of the table is represented as an example. The structure of the table is part of the representation of an information demand pattern proposed by Sandkuhl [6].

Information demand	General importance	Accurate	In realtime	Complete
Business environment	decisive	decisive	high	high
Internal and external factors	decisive	decisive	decisive	decisive
Project specification	decisive	high	decisive	decisive
Change requests	high	decisive	high	decisive
Project progress	decisive	decisive	high	high
Stage- and project tolerances	decisive	high	decisive	high
Project risks	decisive	decisive	decisive	decisive
Project close-out	high	decisive	high	decisive
Field Report	nice to have	high	nice to have	high

Fig. 2. Quality criteria for the information demand of the steering committee.

Effects arise when the required information is not available or not available in time. The effects are described in a short text and a table. The following examples analyze economic effects:

The economic consequences arise from missing or incomplete information and lead to additional costs to the project. This can be the case if contractual agreements with the customer are not observed. Furthermore, risks and changes can lead to additional costs, because more time and more resources are needed for the project. Besides that deviations of project and phase tolerances accumulate to additional cost factors. A lot of harm can result from breaking off the project for the enterprise. On the one hand, this harm can

arise from a decline in sales volume and reduced income, particularly if the project result should be commercialized. On the other hand, the relation to the customer can be negatively influenced and it can come to an image damage [19]. Altogether these damages can lead to an existential threat for the enterprise.

4 Validation

The investigation in the course of validation aimed at checking the created sample information demands of the individual roles of the steering committee. For this, interviewees were asked about their duties and responsibilities. Then the information about the project are determined, which require the respondents for their roles and responsibilities, so that a subsequent assessment of the importance of information and assessment of the impact of not or not timely available information can be made by the interviewees.

The interviewees were representatives of the following roles: client, project manager, users representative and suppliers representative of an internal university project. The project is a technical and functional integrated web-based university management system for all processes and structures within universities regarding any type of organization and size.

4.1 Setting

The interviews were conducted with members of the steering committee in a joint interview. Through the interviews, expectations, opinions, and reviews the general position that the members roles should be identified and analyzed in the project. In this context, the interviews were conducted to identify information demands, so that the interviews consisted of two parts. To the members of the steering committee an interview request by e- mail was sent followed by telephone inquiries. For the full interview on objectives, success factors and information demands for about one hour was scheduled.

A total of five interviews with a project manager, a customer and supplier representatives, and two user representatives were conducted. These were individual interviews. The interviews were designed by using guided questions, so that they were easy to understand and to answer. In average the interviews last thirty-minute, the interviewees were asked about the following points: tasks, responsibilities, information demands, estimated meaning of the information and estimated impact of missing information.

These points followed the outline of the information demand analysis user guide [11]. The questions were initially formulated widely open, so that the respondents could answer free. This allowed us to work out new aspects, featuring the exploratory nature of the interviews. To verify the contents developed from the literature, the subjects were asked about their opinion concerning possible other listed answers.

4.2 Results

The results obtained from the interviews are relevant in two respects for the validation of the original single patterns. Firstly, the individual patterns were validated on the basis of the interviews. The individual patterns were revised to the results from the interviews. This applies for the team pattern, since the contents of the individual samples are summarized in team patterns, so that large parts of the team pattern are validated, too. However, the team pattern contains other content that relates to the entire team, this could not be verified in the present study and will be the subject of future investigations.

The question of whether a team pattern is more than the sum of its individual pattern can be answered affirmatively. In particular, responsibilities and duties of the Steering Committee are quite different from the responsibilities and tasks of each role within the Steering Committee. This suggests that the information demands of a Steering Committee goes beyond the information needs of each role.

Furthermore, it has been shown that there are information demands within the group pattern, which are created by the interaction of the roles involved.

With regard to the structure of a group pattern there is the need for action in order to reflect this additional information demands.

In this way the information from the standards to roles and responsibilities could be supplemented and revised. The information derived from these requirements could also be checked. In particular, the questions about the assessments at the time of deployment, the importance and the impact of information are an important part of the interviews. With the help of these interviews the pattern could be verified by experts and re-evaluated on this basis.

For this purpose, the original classification of the author has been compared with those of the experts from the interviews. As the experts expressed their thoughts on the classification during the interview, additional experiences and impressions were gained.

This is particularly important for the development of the team pattern, since this is based on the individual patterns. It should be noted that only the parts of the team pattern could be examined, which results from the sum of the individual patterns.

5 Conclusion

The work presented in this paper extended work done concerning information demand pattern by adopting the structure of information demand pattern for single roles and extending the principles for a team.

The use case to develop the team pattern was a steering committee of a large project. Therefore the detection of roles and teams in project management was required. For this purpose three standards of project management were investigated in literature to identify recurring roles in steering committees. On this basis four single patterns were developed and validated. Then one team pattern was derived out of the single pattern.

As a part of validation an empirical study using semi-structured interviews were conducted with representatives of all the roles of the selected steering committee. From this process a team pattern, which is composed of the contributions of individual roles and cross-team issues arose. These aspects relate to the function of the team, in this case,

control tasks and decision-making components. These team aspects cannot be expressed by the individual pattern.

New perspectives in the development and application of information demand patterns resulted from the development of the team pattern and by the qualitative research approach. In this context, opportunities for improvements regarding the structure, content and the survey were identified so that future studies could build on it:

Rating scale: a suggestion for improvement relates to the different rating scales in the quality criteria and effects. A new uniform scale is proposed, where the distinction between the individual evaluation items was revised to facilitate the evaluation.

Quality criteria: Another way to improve is aimed at the quality characteristic 'general importance'. Since this is an abstract criterion and the classification is accordingly difficult, it is suggested that the classification of the other three criteria is derived. This could be implemented for example by calculating the median, where the median hired a weighting of individual classifications is conceivable, for example, to form the weighted arithmetic mean of it.

Information demand pattern for teams: As already mentioned a further validation of the pattern is needed. This might be done by a quantitative study.

Interview: Due to the fact that the information demand analysis was investigated and validated several times, there is still room for improvements [14]. These are e.g. the lack of more concrete guidelines.

Furthermore it might be interesting to evaluate other approaches to develop such a team pattern. Conceivable here are interviews with the entire team or other forms of investigation, such as the observation of teamwork.

One useful application scenario could be the implementation of team pattern in current works, which aims at reducing the information overload in e-mail communication of teams by information demand oriented filtering of e-mails using single pattern and recommendation systems [22-24].

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