THE SUPPLY SIDE OF INFORMATION DEMAND: ORGANISATIONAL AND TECHNICAL MEASURES FOR DEMAND ORIENTED INFORMATION SUPPLY

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ABSTRACT

In this era information is considered as an important factor on par with capital, human resources and material. The most important task for an information worker is finding the right information to support the business process and work task at hand. After a time when finding the needed information was a big challenge, we are now in a situation where the problem called "information overload" has arisen. This paper concerns the improvement of information flow within an organisation for a person having a certain role. The focus of the work is on finding the factors (Qualifiers) which affect the information needs of the user and the actions which should be carried out to fulfil them, as well as suitable IT tools. The actions are classified into two groups: Information System Classification and Organisational Measures. The qualifiers are found using interviews with experts from the information logistic field.

1. INTRODUCTION

In many modern organisations, too much information is provided to the employees, resulting in an information overload problem and a lot of time spent to find the right information according to the employees' needs. Surveys show that most of the business professionals that are working with information spend too much time on information finding activities (Lundqvist, 2007).

Information Technology (IT) was expected to improve the productivity and enhance the work situation of knowledge workers. However, the organisational capacity to produce information has exceeded the human capacity to process it. Because of information overload, employees feel stress, strain and anxiety which can damage productivity of the employees. In a survey carried out by Reuters International, managers reported that they need a lot of information to perform their tasks, but they also suffer from health problems because of the information overload (Farhoomand & Drury, 2002).

Information overload can affect a decision in two ways: first, knowledge workers might be unable to find the information they need. Second, it might result in failure in using the information at hand. Besides the difficulties in finding relevant information, there exist problems in sorting, distributing and aggregating the found information. In order to prevent information overload in the lower levels of organisations, it is better to provide the information consumers only with the information channels and information parts which they really need. In some organisations all information is available for everybody, which results in unnecessary information loads for the user (Farhoomand & Drury, 2002).

Another problem in working with information is insufficient and poor software support. Improvements of the information flow in an organisation can save money by direct, as well as indirect means. Besides technical means, organisational measures can be taken to improve information flows, so that the organisation saves costs and time by avoiding unnecessary technical solutions (Lundqvist, 2007).

The contribution of this paper is a categorisation of information needs and supply actions for certain roles in an organisation, empirically validated using interviews with experts from the information logistic field. Proposals for organisational and technical measures supporting information supply are presented. This work

combines the organisational and technical measures at one place. Some of these measures are need specific and some are general which can be used to support the need specific measures and improve the information supply.

2. BACKGROUND

This section presents important preliminaries to understand the concepts and terms of information demand and related areas.

2.1 Information Logistics and Information Demand

The research field information logistics was established in the late 1990s and defined in Sandkuhl (2007). The main objective is optimized information provision and information flow, based on information content, time of delivery, location, presentation and quality.

The information logistics field focuses on improving the information flow by applying logistic principles to information supply. Identifying and providing the right content is a core challenge of information logistics. During the last decade, many IT applications have been developed implementing the objective of information logistics. Some of the applications are services providing bad weather warnings, traffic information or personalized news, and solutions for businesses in different domains like WIND service (weather information on demand), Smart-Wear (location-based information supply for mobile users) (Sandkuhl, 2007).

The concept of information demand is defined by Lundqvist et al. (2005) as *"...the constantly changing need for current, accurate, reliable, and integrated information to support (business) activities, when ever and where ever it is needed."*

This definition implies a number of aspects that must be considered while analysing information demand. Information demand should change as the task, roles and responsibilities, to which information demand is connected, change. The information should be relevant, current, accurate and reliable; otherwise it will contribute to information overflow. The information demand should be integrated with the business activities, as it is necessary to have a solid knowledge about the context in order to be aware of any changes of information demand that might happen. When ever and where ever emphasise the importance of time and location while analysing the information demand (Lundqvist, 2007).

2.2 Information Demand Patterns

Patterns have been used in several computer science areas. Different sources have given different definitions for the term pattern. Information demand patterns is similar to most of the patterns developed in computer science: to capture knowledge about proven solutions to enable reuse of this knowledge. The term information demand pattern is defined in (Sandkuhl et al., 2009) as *"An information demand pattern addresses a recurring information demand problem that arises for specific roles and work situation in an enterprise, and presents a solution to it."*

Similar to other types of patterns, this kind has some fundamental parts which are *organisational context* which identifies the application domain or functions in the organisation forming the context for pattern definition, problems of the role a pattern addresses which are faced by the role in the defined organisational context, *solution* and the *effect* that play in forming a solution. The solution part has three subparts: *information demand* of the role which is related to its task and responsibilities, *quality criteria* is concerned with the accuracy and real time information supply and *timeline* indicate the points in time when the different information parts should be available at the latest. Depending on the purpose, information demand patterns might be designed for supporting one of analysis of problems and situations, design of solutions, or architecture design of information supply solutions. Also, the focus of the under development pattern can be on one of the scopes single role, organisational unit, or enterprise. Figure 1 illustrates the main concepts in the area of information demand and information supply patterns and their relations. The central concept in the Figure 1 is the information demand which is characterized by a qualifier that reflects the quality criteria, contained in the information demand pattern (Sandkuhl et al., 2009).
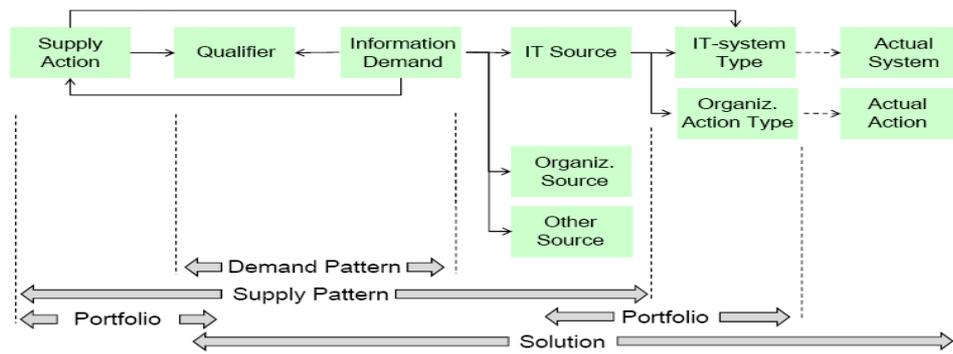
Figure 1. Information demand, supply patterns and technology & activity portfolio (Sandkuhl et al., 2009)

3. RESEARCH METHOD

The empirical material in this paper is based on literature surveys and interviews. The purpose is to find the factors that different roles find important to them when they perform their responsibilities. The selection of informants is an important task, as it will add value to the investigation. In this investigation, the informants are selected based on their roles and different viewpoints on the information logistics field.

Three of the informants are selected from the Fraunhofer ISST, having a technical viewpoint and one of the informants is selected from Centre of Information Logistics (CIL), having a theoretical viewpoint. There are different approaches to interviews that can be used, but for this work semi-structured interviews are suitable. The reason is that semi-structured interviews result in more data, compared to other interviews and allows the researcher to control the direction of the interview, while at the same time allowing informants to introduce ideas and topics which were previously unknown to the researcher (Lundqvist, 2007).

In order to gain a deeper understanding of the information demands and the technical and organisational measures to improve information flow, the following questions were posed to the informant.

1. What are the information needs according to your role in your organisation?
2. What are the factors that can affect the needs mentioned above?
3. What actions do you as a user perform to fulfil your need?
4. What actions can your organisation take to improve information flow according to above mentioned needs and factors?
5. Does the structure and type of information have any role in selecting actions?

4. INFORMATION NEEDS

This section describes the results of the interviews done with the participants. The interviews are analysed to identify the information needs according to the role of the participants and the specialisation of those needs according to the factors affecting them. The results of the interviews are listed below in Table 1. The complete set of the identified needs is available in (Khademhosseinieh and Khan, 2009). We describe the information needs as follows and supported by statements from interviews.

To Send: When information is available and it is needed somewhere else, it should be sent to the target location. The most important influencing factor when sending information is its topic. Based on which topic the information has and which tasks people should do, the sender makes a decision to whom the information is relevant and if should be transmitted. It is probable that an unexpected incident (event) happens and has an effect on the quality and means of sending the information. The sender should be aware of the time factor as well. Sending information after a deadline (if such exist) or before the appropriate time can result in value reduction of the information.

"... we implemented a tool called MailBroker. The main idea is listing certain topics, for example calls for paper or for project or research topic... send the information to the tool ... and the colleagues can subscribe to the tool."

Table 1. Information needs with associated qualifiers and actions

Need	Qualifier	Need specific action(s)	General action(s)
To Send	• Time Based • Topic Based • Task Based • Event Based • Profile Based	• Send email • Make phone call • Send information to the topic based tool • Compose email • Use group based server (intranet)	• Organisational units must coordinate their activities • Select organisational structure with respect to the working environment • Increase sharing of information between organisational units • Use lateral relations(direct contact, liaison role, integrator role) • Train people for interpersonal skills • Reduce role ambiguity • Allocate proper time to task • Define gatekeepers role • Delegate responsibility to a role • Use feedback loop • Provide the amount of information to employee which they can handle • Consult colleagues or supervisor • Prioritize information and work task • Flatten management structure • Provide access to information sources • Internal employee transfer • Adopt organisational design to reduce information distribution • Communicate task goals • information distribution • Define standard operating procedures, routines and scripts
To Extract	• Relevancy • Feature Based • Structure Based	• Extract information based on user interests • Extract information based on document features • Extract information based on document structure	
To Categorise	• Topic Based • Task Based • Format Based • Organisation Based	• Save in topic based document system • Make personal storage folders (e.g. email folder) • Classify information according to the topic	
To Filter	• Attribute Based • Relevancy • Rule Based • Profile Based	• Use spam filter • Check name of sender and the subject • Define filtering rules • Talk to colleague • Use repel technology	
To Distribute	• Rule Based • Topic Based • Relevancy	• Define routing rules	
To Customise	• Task Based • Situation Based	• Talk to colleagues	
To Receive	• Time Based • Location Based • Topic Based • Attribute Based • Format Based • Accessibility • Feature Based • Content Based • Presentation • Situation Based • History Based	• Contact colleagues (read brief letters) • Subscribe to topic based service and the time based tool • Register in subscription service • Subscribe to newsletters • Networking (participating in regional clustering activities) • Contact personally	

To Extract: For extracting information, not all information pieces can be used. Rather, the qualifier *Relevancy (to the topic)* determines which information piece(s) of information that can be used for taking data fractions out and combining them.

"... you have to check the partner's search request and then you can keep the ones that are relevant to you."

To Categorise: Making categories of information makes some future tasks (e.g. batch processing, finding, etc.) easier, and different factors can have an effect on this task. Categorization should be done with respect to the project and the task, but these are not the only affecting factors for categorizing information. The categorization might completely change in the case of changing the organisation. The format of the information can be another factor which should be taken into account while categorisation, if it has been mentioned as a notable factor.

"... I do have my own storage structure on the laptop... and my email folders... to classify this kind of information, so that retrieval at the point of time when I need the information becomes in certain sense easier..."

To Filter: Sometimes it is necessary to use filtering on a stream of data. By filtering, the part of the information that is not needed will not be able to pass to the receiver. In order to do filtering, it is necessary to know about user's preferences and interests, which have been saved as user profiles. Moreover, a user defines some rules that the system use to make decisions about which parts of information should be filtered. Another factor in filtering is the relevancy of the information to the task and project.

"We have spam filter, works very effectively in our organisation... I have no activity on my own, so I don't have self-configured spam filter..."

"One the hand side is concerning email by using this kind of filter tools... mails coming from person X should be directly routed to some of my department heads."

To Distribute: Distribution means broadcasting information to more than one user. It is not a blind try. For distributing information, the first matter that should be considered is the topic of it, since not all users are interested in all topics. Also, it should be checked whether the information is relevant to their task (relevancy), and if it is to what extent. Distribution makes use of some rules that have been defined that establish, how to distribute the information, what should be distributed and to whom it should be distributed.

"...I send information to a tool and classify the information... [colleagues] can subscribe to certain key words... the tool because if subscription sends information to the colleague."

To Customise: When some information arrives, its presentation should fit the task. Many times, although the received information material is useful for the task, its formulation is not appropriate. When this condition occurs, customisation will be done according to the task. Attention should be paid to how the situation affects customisation.

"... I have to be prepared; preparation mainly comes from my colleagues by briefing letters and the things like that. So the information is in these kinds of briefing letters. I have to be prepared in order to discuss and negotiate with the customers."

To Receive: Receiving information as the main goal in an information flow can be affected by different factors. The most influencing factor when receiving information is time. Information that has been received too late (and even in some cases too early) has no value. The other important factors when receiving information are the topic and the content of the information. The receiver is interested in receiving information content about a certain topic that fulfils his information needs. The user who wants to receive the information might also care about its features (language, multi-word concepts...) as well as its format. Other properties of the information are attribute, presentation, the accessibility of the information, previously received information (history), and the current state of the surrounding environment (situation).

"...I need certain information when the meetings are... the information I receive after the meeting is of no importance."

5. CLASSIFICATION

In this section the actions identified are classified into different categories as they are required to satisfy an information demand that can be based on IT sources or organisational sources. The classification consists of two groups; information system classifications and organisational measures.

5.1 Information System Classification

There are some actions identified, which are related to changes in the information systems, and are categorised under this classification. They are categorised in general categories instead of mentioning actual systems, since a new system can replace the existing system.

5.1.1 Subscription Service

Subscribe to topic based service: Using a service which sends the information to the users based on their selected topics of interest will reduce the information overload.

Subscribe to newsletters: A newsletter is regularly distributed information to subscribers.

5.1.2 Filtering Systems

Use spam filters: One of the reasons for information overload is receiving too many emails. To avoid getting irrelevant emails, users should use appropriate spam filters for the emails.

Define filtering rules: The user can define the filtering rules based on keywords matches in the email messages. There is a certain kind of structure in the mails, such as sender information, and the rules can take advantage of that structure. The rules can be defined to delete all the messages from some specific sender or mark some keywords as urgent.

Use repel technology: It is sometimes necessary to avoid certain kind of information reaching a user. For this reason, like pull technology can be used for getting information, repel technology can be used to prevent the unnecessary information reaching the machine. With this technology a user can select highly relevant parts of information, ignoring the rest of it. Software agents, with information customization software, integrated with push and repel technology, to limit that amount of information that the individual originally receives, moving the responsibility for the organization, prioritization and ranking of information messages to agents, so that information is filtered prior to reception, thus stemming the flow (Ellington, 2005).

5.1.3 Classification Systems

Classify information according to the topic: It might be needed to categorise the information according to its topics. It will help the user to locate the information according to the category of his interest.

Send information to topic based service: There is a need to distribute information to all the people in the organisation who are interested in that piece of information. But because of the organisation size, knowing about all the people who would be interested in that piece of information is not possible. Instead, this information can be sent to a service which categorise the information according to its topic and forwards the information to anyone in the organisation that have registered interest in that topic.

5.1.4 Archiving/Document Management System

Make personal storage folders (e.g. email folders): Every role can have a personal storage mechanism for storing the documents for later retrieval. That storage structure is completely dependent on the personal characteristics of the employee in that role.

5.1.5 Mining Systems

Extract information based on user interests: Sometimes it is needed to extract portions of the information according to the user's interests. These interests can include the features of the information, the topic and the structure of the document. For such actions it is necessary to have tools which can extract this information from the document collection and provide the user with the relevant parts of the information. One of the examples of mining system is the IBM Intelligent Miner for Data and the IBM Intelligent Miner for Text, that provide the most advanced and comprehensive set of solutions for information mining (Tkach, 1998).

5.2 Classification for Organisational Measures

In the area of the organisational measures, the actions need to be classified according to the structure of the organisation (structural related) and the work flow (work process related). The actions related to the organisation structure involve changes in organisation structure or the role in order to provide required

information to the roles that need information. Actions related to the work process involve changes in the work process or adding new work processes (Sandkuhl et al., 2009).

5.2.1 Structural Related Actions

Adopt an organisational design to reduce information distribution: The one solution to reduce the risk of information overload on the organisational units is to adopt an organisation design which minimise the need of information distribution among the organisational units. One of the ways to achieve this is by establishing the lateral relationships which moves decision making down to where the problem is in organisation. There are different types of lateral relations, like Direct Contact, Liaison Roles and Integrator roles (Duncan, 1979).

Define gatekeeper role: It is sometimes needed to introduce a new role in the organisation to improve information supply. The task of this role is to identify external sources of information, then acquire information from these sources, interpret, screen and translate that information in a meaningful language for the colleagues. Finally, the refined information should be distributed in the organization (Morrison, 2008).

Provide access to information sources: Granting access to the information that the users or organisational units need is crucial. A specific information piece might be accessible from several distributed, autonomous, diverse, and dynamic information sources. In such a case, granting access to the right and relevant information is complex. Therefore, it is important to make sure that the most suitable source has been selected. Some approaches for this are using agents, describing relatively the contents and query capabilities of information sources and exchanging information by object exchange (Levyl et al., 1996) and (Papakonstantinou et al., 1995).

5.2.2 Work process Related Actions

Increase sharing of information between organisational units: The organisational units have to share information between them as the cost of making a wrong decision is increasing in terms of the sunk cost and in terms of losing market share. Since such wrong decisions sometimes results from a lack of contact between divisions, it emphasises the need to have more coordination across divisions and more sharing of information. For example, the top management team which comprises of departmental managers should meet regularly, it will increase the opportunities of interaction between these managers and also they can share the information and lessons learned. By this way they can build on one another's expertise and competence and ensure the required coordination (Duncan, 1979).

Train people for interpersonal skills: The employees in the organisation should be provided with training to improve their skills in communication and problem solving, so that they can better communicate their ideas and acquire the information they need to perform their task. For example, we can train the people for: Social skill role-taking and role-playing ability; talent for building and maintaining relationships (peer and boss relations, self-presentation and impression management, listening and negotiating, oral and written communications, customer focus, approachability) (Hogen and Kaiser, 2005).

Eliminate redundant information: When an organisation works with an information system, it processes the existing information. These processes produce new information, as well as some information that is not new to the system. The latter causes redundancy, which is one of the main causes of information overload. This redundant information should be eliminated frequently. For example, De-duplication is process through which redundant information is identified and removed (Geer, 2008).

6. CONCLUSION

The main purpose of this work is to contribute to improving the information flow for a specific role in an organisation. To achieve this goal, we have proposed some supply actions for improving information flow according to information needs. The results are empirically grounded in interviews and literature surveys and will contribute to personalisation and individualisation of information systems.

The supply actions are classified in two groups: *IS Classification* and *Organisational Measures*. For the *IS Classification*, the supply actions are categorised according to the general information system types which can be used to improve the information supply. In *Organisational Measures*, the actions are categorised according to the changes that can be made based on organisation structure or work process.

Some of the actions are specific to qualifiers of an information need, while others are not related to the qualifiers of a specific information need, but they can be used for fulfilling specific needs. Also some actions are identified, which are not related to specific need but can be used to improve the information flow within an organisation.

The main limitation of the presented work is the lack of experimental validation of the results. We intend to perform an initial validation in an academic context and extend it towards industrial user after reviewing the initial results.

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