

A Study on Complex Information Needs in Business Activities

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Abstract

The primary interest of the research presented in this paper lies in the area of complex information needs. A study of awareness of complex information needs and their features has been undertaken to gain insight into the user side of user-IT relation in meeting complex information needs in business. The research has used a survey of Lithuanian business middle-to-senior managers to elicit their responses on the issues of features of complex information needs and environment monitoring. The respondents confirmed the heterogeneous nature of complex information needs and pointed out the most important groups of information monitored on a permanent basis, the top three being competition and market information, accounting and financial information, and customer information. The analysis of monitored information in the terms of information monitored together has disclosed some patterns that might be useful in providing an integrated view of activity environment and assisting in possible emergence of complex information needs.

Keywords: complex information needs, environment monitoring, decision support.

Introduction

In complex and dynamic contemporary business environments the existing variety of activities creates the variety of information needs. We can describe an information need as a motive to use information required to support people engaged in certain activities. Such understanding of information needs is related to the definition of informing, as provided by Cohen (2009) in his paper on Informing Science: "The task of Informing Science is to provide the clientele with information in a way that maximises its effectiveness." The variety of information needs differs by a number of features: management level, business or activity area, formality, scope, urgency, complexity, and others. Based on the authors' previous work in the area of decision support information needs (Skyrius, 2008; Skyrius & Winer, 2000), the primary interest of this paper lies in the area of complex information needs (CIN). Although the field has been and currently is attracting considerable research efforts, it still is one of the most interesting and under-researched segments in the information needs variety. The research presented in this paper has taken a pragmatic approach – to gain insight into the user side of user-IT relations in meeting complex information needs in business.

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The user side has been rather well researched in terms of generic issues around information needs. However, in terms of different complexity of information needs there is considerably less research available. As well, in terms of differences of information behavior in different fields of activity (students, sci-

entists, business people, individual users) the business users' information needs have been much less researched on the complex side.

In published work in this area (of complex information needs and related issues), some neighboring dimensions come up: simple informing versus complex informing (Gill & Cohen, 2008); routine informing versus non-routine informing (Gill & Cohen, 2009); technology-centered systems versus human-centered systems (Jaimes, Sebe, & Gatica-Perez, 2006; Kling, 1996), and so on. The common feature of such dimensions is that they distinguish simple, repetitive, and mostly technology-centric approaches from fluid, complicated, and heterogeneous user-centered or needs-centered approaches, where behavioral and contextual issues are of prime importance. The latter approaches might require such non-trivial (and hardly programmable) tools as intuition, improvisation, and drifting (Ciborra, 2002).

The importance of research in the area of CIN in business is rather evident from the nature of activities that create such needs – decision making, analysis, insight development, project conceptualization, etc. These activities, related to sophisticated information engineering, usually are of high expected value, but at the same time risky. The user survey data from previous research, mostly on business decision support and IT role in providing support, showed that the proper balance of support is between human and IT functions, where IT does all the hard and dirty work, and the flexibility options are selected by the human actor. The nature of such balance is difficult to estimate, especially in the sector of CIN, and decision support needs are attributed to this sector. Consequently, a decision has been made to investigate further into this segment of information needs.

The purpose of this paper is to present research on the user side of user-IT relations in meeting complex information needs and to clarify the definition of complex information needs in business activities. The focus of the paper is the business activities and environment of Lithuanian business entities (mostly) and public sector institutions, with the aim to examine the nature of CIN, their relation to user activities, and their overall information environment. This is done by using a questionnaire to extract user opinions and attitudes towards CIN and by combining its results with the authors' earlier work in this area.

The structure of the paper is as follows. First, it discusses existing research in the field of information needs and related issues. Then, it describes the features of information needs, with attention to CIN and IT role in satisfying them. The next section presents the survey, its results and their discussion. Finally, it discusses the findings and conclusions.

Existing Research

The evolution of insights into information needs of contemporary professional users has attracted considerable attention from the research community. The research has experienced developments in the related fields of information behaviour, information seek, search and use (simple use, production of new information, triggered action and/or additional search, further transfer into workflow chain), sense-making, etc. Among works closely related to information needs are works dedicated to information seeking process (Dervin & Nilan, 1986; Kuhlthau, 2005), information behaviour (Johnstone, Tate, & Bonner, 2004; Wilson, 2000), information seeking support (Levi, 2008), task role in information studies (Byström, 2002), environment scanning (Choo, 2001), complexity issues in information needs (Albers, 2004; Allen, 1996) and others. Also, research on decision making initial stages (Auster & Choo, 1994) is closely related to complex information needs, as it concentrates on the issues of environment scanning, problem recognition, and definition of information needs.

In information seeking and use situations, Cheuk (1999) describes several types of situations (new situation, transitional situation, facts situation, problematical situation, decisive situation)

for different stages of information seeking and use, and several types of environments (technical, social and personal work) with two levels of complexity: simple and complex. The complex part of the environments coincides rather well with the features of complex information needs revealed by the questionnaires – heterogeneity in technical tools, social environment, and personal work environment (Thivant, 2005), and multitude of information sources, information procedures, actors involved, significant role of external information (current research described in this paper). Marcella, Baxter, and Davies (2007) investigated the information needs and information-seeking behavior of the users of the European Parliamentary Documentation Centre, finding out that emerging complex information needs should not be intended to be satisfied by simple means, like Internet search engines. Huotari and Wilson (2001) specify that “the literature on *corporate* information needs is noticeably much less extensive than the literature on information needs and information-seeking behaviour of individuals as organizational actors or members of particular professional groups.”

The Features of Information Needs

The complex side of information needs, including needs for decision making and other high-level information activities, is rather complicated to fulfil for the reasons that have been named in a number of works from early stages of DSS research (Keen & Scott-Morton, 1978; Sprague & Carlson, 1982) to more recent work in the field (Melchert & Winter, 2004; Nakatsu, 2004; Reddy & Spence, 2008). Among the most often mentioned reasons are multi-faceted information from assorted sources, limited time frame (usually), need to decide with incomplete information, and need to adapt to environment changes.

As specified above, this paper is intended to provide insight into the variety of information needs with principal attention given to complex needs. A careful approach has been taken, keeping in mind the temptation to suggest some kind of pre-programmed tools or techniques for automated satisfaction of information needs. The differences between simple and complex information needs are more or less obvious; we can define the principal differences between simple and complex information needs as follows.

Simple needs are of routine nature, based on clearly structured questions leading to routine actions or simple decisions; they use data from a single source or a small number of easily accessible sources; procedures to produce results are few and mostly controlled by single own information system; results are a direct product or simple by-product of existing information system.

Complex needs are much less of a routine nature; they are often based on vaguely structured questions; require composite results drawn from data sources that are numerous, incompatible, eclectic and often external; use heterogeneous data and procedures; there is an increased role of soft information and judgment; the sources and conditions of their use are not controlled by own information system; such needs cannot be exactly estimated beforehand and are hard to plan.

Complexity, as it is understood here, can be estimated by evaluating features like:

- number of procedures and stages required to produce the result,
- number of information sources to be used,
- number of dimensions to be considered – business, technical, social, political, environmental, etc.

Situations that invoke complex information needs are usually some kind of problem situations requiring decisions and experiencing potential risks (e.g., crisis, market crash, aggressive move

by competitors, natural calamity) or rewards (e.g., market niche, significant innovation, new business model). Few examples of situations with complex information needs:

- if a worsening situation is recognized – e.g., dropping sales or increasing flow of customer complaints – what forces have caused this worsening, and what measures would lead to what outcomes?
- what is the estimation of possible risk associated with new competitors?
- in an acquisition deal, what does the buying side need to know before the decision of go/no-go (data rooms, public information, due diligence, own sources, ...)?
- what is the nature and severity of the emergency situation? Some issues of possible information needs for an organizational emergency are discussed in “Supervision of Financial Conglomerates” (1999) and Choo (2008).

The multifaceted nature of complex needs suggests some dimensions for their possible classification, with subsequent differences in satisfaction approaches.

- **Urgency.** One extremity is emergency situations that need quick yet well-grounded decisions in a fast-changing environment; the other pole is non-emergency situations – e.g., acquisition, privatization, strategic foresights. Support-wise, urgent needs should require the presence of emergency informing systems.
- **Coverage.** On one hand, there are situations with wide scope, affecting the whole organization; on the other hand – a narrow yet complicated problem area; in the latter case we deal with reduced set of dimensions, and at the same time the need to go down into the “information silo” of the narrow area.
- **Required precision.** In some cases, a rough estimate of a situation is sufficient; in other cases, exact or near-exact results are required. For rough estimates there are “quick fix” models; for accurate calculations and estimates issues of source information quality and reliability come up. This dimension is related to urgency in a sense that urgent situations usually do not allow for time-consuming thorough estimates and have to deal with quick and rough assessments.
- **Heterogeneity,** defined by many or few information sources, procedures, or participants. Highly heterogeneous needs would require information integration mechanisms for source heterogeneity; unified or transparent environments for procedure integration; convenient communication channels for participant input integration. This dimension is related to coverage in a way that problems of a wide coverage invoke use of a number of information sources, procedures and participants.
- **Structuredness.** Although complex information needs by their nature are on the unstructured side, variations are possible in a sense that some problems possess more structure than others – e.g., in the area of company mergers and acquisitions the principal set of procedures, although rather complex, is known beforehand; the launching of an innovative business model which had not existed before is considerably less structured.
- **Associated risks,** defined by size and probability of possible loss if incorrectly assessed. The high-risk situations require the use of risk-estimating procedures and evaluation of different scenarios; information triangulation and cross-checking for reliability of multiple sources might be used for increased reliability of results.

An important issue in understanding complex information needs is the transition from initial detection of a problem situation to a problem-specific focused search and analysis. The structural pattern of such transition is along the lines of several well-known models of information activities, namely, Kuhlthau's ISP (information search process) model (Kuhlthau, Heinström, & Todd, 2008), Wilson's model of information behavior (Wilson, 2000), Cheuk's information seeking and use process model (Cheuk, 1999), and others. In practical terms, it is important to understand how such transition could be supported by the features of users' information environment, satisfying common everyday information needs and at the same time providing tools and techniques to present a complete picture of activity environments, notice issues worth attention, or invoke necessary alerts. With respect to this transition, one more dimension of information needs can be introduced regarding specific attention for a certain situation. The routine, repeating needs can be named *common needs*, and specific, non-routine needs that zoom in on a certain problem are *special needs*.

Common needs are of permanent nature and are known beforehand; the satisfaction procedures are clear, programmed and reusable; all important areas of activity are given roughly the same attention; closely related to Choo's term "environmental scanning" (Choo, 2001).

Special needs emerge for a specific situation; require extra attention and analysis; are of semi-structured and unstructured nature, random and hard to plan; the reuse of their procedures is limited.

IT role. The transition from data to understanding influences the design and functionality of information environment. Regarding the role of information technology (IT), it has always been considered a technical platform to satisfy information needs by providing tools and techniques that are required to manage information in the best way possible, and at the same time it creates new possibilities and offerings for information users. A large number of new technological innovations has appeared in the last 10-15 years – wireless networks, pocket terminals, remote and cloud computing, powerful analytical software, to mention a few.

While IT innovations are intended to provide better support for the users and their needs, they serve only one side of human-technology relation. The higher the complexity of managerial activities and information needs, the less recurrent are patterns of sense-making and problem solving, and their "softwarization" potential goes down because of non-repetitive nature, limited reuse, and constantly changing sets of information sources and procedures. Hill and Scott (2004) state that although the value of IT in monitoring environment and supporting BI functions is recognized, it is deemed risky, and its implementation is reluctant. An expectation for a simple satisfaction of a complex managerial information need by the use of IT can be compared to coming to a foreign place and expecting it to be arranged in familiar order and standards. One of the possible directions for solutions in this area is the proper split of functionality, efficiency, and flexibility between system and user, leaving more flexibility and choice on the user side. An important factor in this case is information proficiency of the users and their skills in information activities – planning information search, searching and filtering, evaluating and sense-making. Complex information needs require **user information skills** which should develop more in working with sense and problem solving and less in mastering technology approaches.

Survey and Results

To gain more insight into features of complex information needs and users' attitudes towards them, a questionnaire was distributed among business information users and decision makers in the Lithuanian business community. The questionnaire covered the following areas:

- features of complex information needs;
- constantly monitored information;
- accumulation of decision experience.

In this paper, only the first two areas are considered. The questionnaire was distributed to a group of Master’s level students in the School of International Business at the University of Vilnius, Lithuania. As the group is comprised of people employed as middle-to-senior business managers, it can be regarded as a convenience sample in the community of business decision makers. The survey yielded 203 responses. Some questions permitted multiple answers, so the totals of responses in Tables 2 and 4 sum to more than total number of respondents. The composition of the surveyed group by the area of activity is presented below. It should be noted here that although all the respondees provided answers to the questions regarding information needs, not all of them did specify the size of the organization and the area of activity out of confidentiality as one of the prerequisites of providing the answers. The mean size of a surveyed organization is 465,8 employees, with median being equal to 50. This can be explained by the presence of a couple of large companies in retail and communications, having respectively 20,000 and 10,000 employees.

Services	49
Trade – wholesale and retail	36
Finance	11
Production	9
Transportation, logistics	8
Communications, media, publishing	6
Public sector	4
Construction	4
Energy	4
Information technology	3
Health care	1
Did not specify	68
Total:	203

Features of Complex Information Needs

Question 1. Do you agree that information needs are of non-uniform complexity?

This simple question was intended to check the awareness of the surveyed group of the variety of information needs in question. The responses are presented in Table 1.

Table 1. Awareness of non-uniform complexity of information needs

Yes	202
No	0
Do not know	1

The awareness of the non-uniform complexity of information needs among the surveyed group is almost unanimous.

Question 2. If your answer for the Question 1 has been “yes”, what features are characteristic to complex information needs?

The answers are presented in Table 2.

Table 2. Features of complex information needs

Require a group of procedures to achieve the desired result; a single procedure is not sufficient	139
Require information from a number of sources to achieve the desired result	122
Require external information (not available inside the organization)	107
The needs emerge unexpectedly and are hard to plan	77
The needs are vaguely defined	76
The growing importance of „soft“ information (opinions, estimates)	61
Other:	14

The answers given in the “other” category point out difficult access to information sources and their incompatibility (3 responses), complicated decision analysis (3 responses), urgency (2 responses), involvement of additional manpower and specialist help (2 responses), reliable selection of required information, complexity of own activities, negotiations between stakeholder groups (1 response each); 1 response had reflected misunderstanding of the question.

From the answers in Table 2, it is clear that this kind of information is seldom available in the organization’s information system and ready for use. The first three groups that represent the majority of answers (61.7% of the total of 596 responses, or respectively 68.5%, 60.1%, and 52.7% of the number of completed questionnaires) can be considered key factors of heterogeneity of information needs, driven by the need to reduce uncertainty and achieve satisfactory completeness of the problem view.

Question 3. Do you encounter information needs in your activities that can be considered complex?

The answers are presented in Table 3.

Table 3. Complex information needs in respondees’ activities

Yes	182
No	17
Do not know	3

The majority of respondents did encounter complex information needs in their activities, which is in line with their duties as middle-to-senior level managers. Although there are 20 responses, or 9.9% of the respondents that are negative or unsure about the existence of complex information needs in their activities, this can probably be explained by the understanding of CIN as issues that happen seldom, and mostly in the higher echelons of management.

Constantly Monitored Information

Question 4. When monitoring the environment of activities, what information should be constantly at hand (up to 5 types)?

In our opinion, this question, although aimed at common and simple needs, is meant to aid the possible disclosure of the relation between CIN and permanently required information-at-hand in terms of a starting point for a number of situations with CIN. The monitoring functions, supported by IT, are intended to aid in discovering specific issues requiring attention, to trigger alerts, or to raise general awareness. The most frequently indicated issues under day-to-day monitoring are presented in Table 4.

Table 4. Groups of information monitored most frequently

Information group	Number
1. Competition and market information	136
2. Accounting and finance	100
3. Customers	72
4. Sales and turnover	62
5. Inventory	39
6. Legal regulations	38
7. Projects	37
8. Personnel	34
9. Production	30

The data on the most often monitored information sources is quite similar to data collected in Lithuania in the years 2004-2006 and presented in earlier work by one of the authors (Skyrius 2008), where the top five places are:

- current status information – cash flow, liquidity, payables/receivables etc.;
- market information – competition, innovations, trends;
- own performance information: how efficient is the creation of value; ratio of outputs to inputs;
- competence information: principal competence drivers and their status;
- the availability and use of assets.

In both cases, although separated by three years, the distributions are quite similar, pointing to importance of monitoring the organization's own status or close environment, and thus focusing the attention on the relation of competitive environment and own potential. The distribution of the above data is not very significant by itself and hardly reveals much more than what is shown.

However, in our opinion, the possible “basket analysis” of the constantly monitored data might reveal combinations of data monitored together in a way that is more informative than just plain monitoring of separate types of information. As the research described in this paper is still underway, only an attempt of such “basket analysis” has been made by looking for combinations of information types monitored together. The relatively modest size of the sample did not allow for substantial statistical significance, so just a simple count has been performed. Only the first six groups of information from the Table 4 have been accounted for, as these were the groups with the highest count and consequently more likely to be present in the sets of information being monitored together. The results are presented in Tables 5 and 6. Table 5 contains the most frequent pairwise combinations of information being monitored together, and Table 6 contains most frequently encountered combinations of three.

Table 5. Most frequent pairs of monitored information

Information groups		No. of cases
Market and competition	Accounting and financial	16
Market and competition	Sales and turnover	8
Accounting and financial	Sales and turnover	7
Sales and turnover	Customers	5

Table 6. Most frequent triples of monitored information

Information groups				No. of cases
1.	Market and competition	Accounting and financial	Customers	10
2.	Accounting and financial	Sales and turnover	Suppliers and inventory	7
3.	Accounting and financial	Customers	Legal regulations	5
4.	Market and competition	Accounting and financial	Sales and turnover	5

The most frequent pairs of information in Table 5 show closely related issues that would be relevant to any business activity. The triples in Table 6, in our opinion, provide more information on a monitoring pattern: groups 1 and 4 are aimed towards understanding the current market dynamics; group 2 leans more toward ensuring smooth own activities; and group 3 shows the attention given to conformance to legal regulations. Of course, such simple profiling has limited practical use, but it is expected that the ongoing research should provide more empiric data and increase reliability and usefulness of the results.

A more substantial analysis of user demand for certain combinations of monitored information might allow inferring about a composite monitoring view where different types of data complement each other. Such “basket analysis” might provide support in satisfying CIN, and in the first place random CIN that emerge unexpectedly, by:

- designing user’s workspace with the sets of monitored information in mind, so that key groups of information and their relations are easy to watch, and other groups of informa-

tion can be included in the view if required; if information presentation uses a dashboard of any kind, this approach should be able to assist in efficient selection of monitored information;

- providing possible raw material (combined time series, correlations) for detection of important issues;
- possibly providing information integration by producing derivative estimates and ratios that allow more everyday insight and diagnostic power; by doing this we move from common-simple to common-complex sector of information needs; this part of CIN, served on a permanent basis, can provide additional clarity if a problem case emerges;
- triggering additional information needs to elaborate on an issue once it is noticed – assessing payoff/loss, risks, resources available and required, etc.

Conclusions

The research approach concentrates on complex information needs – a problematic type of information needs because of high expected payoffs and risk of improper satisfaction. The insight into the features of CIN has confirmed their heterogeneous nature in the terms of multiple types of information, multiple information sources, multiple procedures and participants for their satisfaction. The emergence of CIN is often unpredicted, the related situations often have pressing deadlines, and the development of programmed solutions for these purposes is hardly feasible. The subdivision of information needs into simple/complex and common/special can assist in understanding user requirements for each type of needs and in understanding issues of transition between these types when dealing with a certain problem. Many sources have stressed that user awareness is an important feature in the face of CIN emergence and that efficient monitoring of activity environment can be helpful in dealing with the problem. IT role, as discussed in the authors' earlier work, is supposed to be of supportive nature – more user pull than technology push, and letting user be more flexible and creative.

The results of the part of the survey covering the constantly monitored information have shown that it is possible to perform a “basket analysis” of the types of monitored information and discover patterns of information groups monitored together. The discovery of such patterns can assist in designing the user's IT-supported workspace, though the issue of meaningful patterns requires more research to justify or reject their usefulness. Regarding the possible detection of a problem and subsequent emergence of CIN to solve that problem, the discovered patterns can be further integrated into derivative estimates and ratios to allow more insight and diagnostic power, and by this covering a part of the CIN to be met.

The described approach is related to the authors' former presented model of decision support activities (Skyrius, 2008) with two layers of support – one being close and easy to use, other being more complex and heterogeneous. The first (close) layer serves only simple/common needs, and the need to address some special issue by using the functionality of second (outside) layer carries the required complexity to meet complex needs if a case emerges. The research presented in this paper is still underway, and the further research is intended to obtain more empiric data to obtain statistically reliable results. It is also intended to find out how environmental changes influence changes in monitoring approaches and techniques. One more part of the planned research will be given to issues of preservation, use and reuse of experience information that is produced every time there is a need to deal with CIN in problem solving, decision making and related activities.

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Biographies



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