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METHOD FOR MEASURING INFORMATION OVERLOAD[12]

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Abstract: *Information exchange between members of an organization or company, as well as within teams and communities of practice working on certain tasks, is an important element of their activity. This exchange is a necessary part of knowledge management in the organization, especially when it produces technological products. Making right decisions depends on knowledge gathered through different communication channels to a high extent. Insufficient and extra information can negatively affect the quality and results of decisions. There is no general methodology for estimating information load. Our goal is to provide a model for measuring information loads in teams or organizations, sharing knowledge between their members, and associated consequences of making the right decisions. Give an assessment of the quality of the information exchange and indicate whether it needs to be improved.*

Keywords: *Knowledge Management, Information Overload, Measurement, Methodology*

INTRODUCTION

Every decision is based on some information or knowledge available or collected in advance. Well known is the impact, which the amount of information processed causes over decision quality. Information overload (IO) is a state in which the received information is too much, and the result is that an individual cannot process it. Therefore, he rejects or filters only a part that is necessary for him to make a decision. This filtering creates a risk of rejecting valuable pieces of information, which inevitably makes decisions less effective. Insufficient information has an effect similar to overload. Insufficient information can hinder performance of certain activities, and on the other hand, insufficiency can easily turn into a bottleneck, due to activities related to obtaining new information on a given problem [1].

The IO can affect many areas of human activity: not only communication on social networks and news releases, but also the information exchange within an organization or between individual teams within the organization. Information overload also has other side effects, such as: impact on people's physical and mental condition, reduced job satisfaction, increased tension in relationships with other team members, personal and family relationships, and can generally lead to a decline in productivity with prolonged exposure.

REVIEW OF EXISTING LITERATURE

Our study shows that in literature investigating IO, little attention is paid to quantitative measurement of this effect. According to Zhang et al. [2] there are three main methods for measuring information overload: subjective scales, performance-based measures, and psychology-based measures. In their study of cognitive load, they used a performance-based method to measure the IO of individuals with autism spectrum disorders (ASD) in their driving skills learning. Measurement is performed with physiological sensors that monitor the functions and reactions of the body and brain

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of learners in real time.

Haksever assesses subjective perception of construction managers in performing tasks at different stages of project development, where the main indicator is subjective feeling of congestion [3]. Results of study form areas of different loads, in which participants can fall with some probability.

Ndumu [1] identifies three main dimensions of IO, each dimension having a number of indicators and attributes that could be quantified. She talks about "scale for understanding and measuring IO". According to her, main dimensions are: behavioral dimension - related to specific individuals, and the relationship between user and information is linear; quantitative dimension - related to volumes of information, where parameters can be the size of artifacts, number of searches, time used to process information, different places where information can be found, and qualitative dimension - related to certain characteristics of information such as novelty, variety, completeness, inaccuracy, complexity, accessibility, truthfulness, etc.

Huang and Lin [4] study the information flow in two different dimension types - diversity and repeatability, where diversity negatively affects decision time, but not its quality.

METHODOLOGY FOR MEASURING IO

Measuring decision quality, as well as information load, are relatively complex tasks, and there is no general methodology for this. Performance-based methods are suitable for real-time load measurement, in processes where a decision must be made relatively quickly within a short time period, and based on data processed in that time. For activities related to technology product development, this is not necessary, so we have focused on a subjective approach to measure information load. We use the information load measuring method based on the subjective perception of the participants in the development process, as they give their own assessment of how loaded they feel when using various organization information channels.

Due to the correlation of two categories, we can conclude about the quality of final decisions, although not precisely. Of course, the quality of a decision is influenced by many indicators, not only the information amount and knowledge used when making it, so any related assessment would be too approximate.

For our experiment, we surveyed participants in the product development process, consisting of many devices and software modules that manage them. Different people have different cognitive abilities. The productivity of the whole team depends on the capabilities of each member when working in teams. All participants in the process of product development and delivery must be well acquainted, if not with all details, then at least with those which can help them in their work when performing daily tasks. Workflow is managed according to a scrum methodology and is divided into small iterative incremental steps. At the end of each step, the product must have a finished look and be ready for use. During their work on tasks, each participant uses different channels to access information needed.

We asked participants in the experiment questions about each of the information channels used by team members. Every question is assigned a weight, and lack of information is associated with the lowest weight, while overload has the highest weight. A model with 4 load levels was chosen, and questions have similar weights in different information exchange channels.

Both high levels of information load and too little awareness have an equally negative effect on the decisions quality. If we conclude about the supposed quality of the team member's decisions, answers with little weight would also have an impact. It should also be noted that the lack of information usually initiates a process of additional information searching, where subjects can easily fall into another extreme of being overloaded with unnecessary information.

To determine the levels of information load in each of the four exchange channels, we ask specific questions for each, which should cover the four levels of this load:

Participation in meetings.

Our goal with this group of questions is to measure how much shared information between team

members, as well as informal meetings and conversations on certain issues related to the work, is sufficient or redundant.

Table 1. Meeting questions

1	The information at meetings is not enough. More meetings are needed.
2	I participate in all meetings, and the information shared is sufficient and helpful. I don't think I'm getting unnecessary or useless information.
3	I participate in all meetings, and some information I receive is unnecessary for me. However, I manage to filter the information that is valuable to me.
4	The meetings I participate in are too much for me. Sometimes I have to miss them. In the meetings I participate in, there is too much information, I ignore most of it, and the helpful information is relatively little.

Use of internal documentation.

This indicator measures the use of internal documentation for the organization. Team members create and share some of this documentation.

Table 2. Internal documentation questions

1	The company documentation is not sufficient.
2	I quickly find documents related to my work. Company documentation is sufficient and well organized.
3	Finding information takes time, but I find what I need. When searching, I also come across information that I do not need.
4	I use internal documentation often, and it always takes me a long time to find necessary information. When searching, I find a lot of unnecessary information for me.

Use of information from the Internet.

Many team members use the global Internet space to help them find information in their work. With the questions addressed to this channel, we aim to assess how effective the search is in the global Internet space.

Table 3. Internet usage questions

1	I do not use external sources of information in my work on tasks.
2	I use the Internet, books and other external sources that can help my work. I find the information I need quickly and easily.
3	I use many external sources of information, and sometimes it takes me a long time to find what is needed.
4	I use a lot of external sources constantly. It is very difficult to find the relevant information, and it often takes me a long time.

MEASUREMENT RESULTS

For the purpose of the experiment, team members in different roles were asked the questions defined above, dividing loads into four levels. The information load was divided into three channels for information exchange - formal and informal meetings on topics related to the activity, the company's internal documentation, including corporate wiki, task management system, e-mail, etc. We also estimated access to public resources on the Internet.

Table 4 summarizes the survey results. The arrangement of roles is according to the degree of the tested load in descending order.

Table 4. Survey results

Team role	Meetings	Internal documentation	Internet	Total
Product Owner	3.33	3.33	3.00	**3.22**
Support	3.00	4.00	2.00	**3.00**
Solution Engineer	2.00	3.50	2.50	**2.67**
Developer	2.86	2.71	2.29	**2.62**
QA	2.67	3.00	2.00	**2.56**
Scrum Master	2.00	3.00	2.00	**2.33**
Other	1.00	3.00	2.00	**2.00**
Total	**2.67**	**3.06**	**2.33**	**2.69**

The data collected can be used to make conclusions about the workloads in different information exchange channels, according to team roles and workload in general.

Load in the information exchange channels.

According to the obtained results, the channel with the highest load probability is the internal documentation. As a conclusion, here we can say that it is necessary to improve the structure and format of this documentation. Better indexing and accessibility, as well as more active sharing of tacit knowledge through this documentation, are also needed. In second place, participants indicated that meetings participation was a source of information load. Here we conclude that meetings as a source of knowledge exchange need to be better organized, and not diluted with unnecessary or repetitive information.

The least load is when receiving information from the Internet. This is likely due to efficient search engines available on the web, and to some extent to the smaller part that this information takes in solving specific company's activities related tasks.

Profiles load.

Not all types of specialists in the teams experience the same load during their tasks completion. Our study shows that developers experience a relatively normal information load, but product owners and support are exposed to overload. For product owners, this situation is typical, as long as they process information from many sources - information from customers, management, developers, as well as any other diverse knowledge related to the development of the product they manage.

Total workload.

Collected data histogram shows responses distribution according to their severity. Using this distribution, we can say what the probability of team members falling under the impact of information overload is. Responses of severity 3 show a relatively low degree of overload, while responses of severity 4 show significant and undesirable levels of overload.

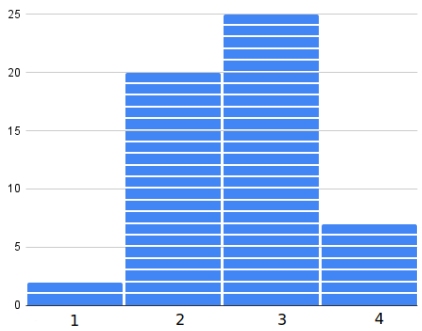

Fig. 1. Responses data histogram

Table 5 shows probabilities that a team member will find himself in an information overload situation. It is visible that low overload levels have the highest probability of 0.46, while excessive

levels are of degree 0.13, and total overload is with a probability of 0.59. In determining teams or the whole organization overload, high levels should be considered, and the aim should be to reduce or control them within certain limits.

Table 5. Load levels probability

Level	1	2	3	4
Probability	0.04	0.37	0.46	0.13

What we need to avoid overloads are answers with values located in the middle of the graph, i.e. the histogram should be as symmetrical as possible. In this case, we can use the coefficient of skewness from probability theory and statistics, which determines how symmetrical the distribution is. The coefficient is a standard third moment of the probability mass function, and is defined as the ratio of the third central moment to the third degree of the standard deviation:

$$\gamma = \frac{\mu_3}{\sigma^3} \quad (1)$$

As its positive values determine the tail of the function on the right and negative - on the left, and show less favorable levels of information load. In our case, the measured distribution skewness in the study is 0.03, which is close to zero and is positive value. This gives us motivation to say that for this experiment, the load levels are still within normal limits. However, greater absolute values could be a cause for consideration. As far as the low levels of awareness are also unfavorable, we can say that the values of this coefficient close to 0 are the most optimal, i.e. when the distribution is relatively symmetrical.

CONCLUSION

Selection of the optimal amount of information needed by participants in the development of a technological product and assessment of its sufficiency or redundancy is a complex process, and there is no uniform methodology for this. Relevant information and knowledge must be obtained within a relatively short time period, given that an agile process is used in the teams' organization. To measure the accuracy of the received information, we use a survey targeting participants in process. A unique thing is that we estimate IO using the response probability distribution coefficient of skewness. In addition to exchange channels, we evaluate various profile loads for participants in processes. Type of information, its quantity, quality, and complexity in different channels and profiles have different effects on awareness and shared knowledge. As a summary of the results, we give a general assessment of the workload in a company developing technological products, and simultaneously make an approximate conclusion about the quality of the decisions made, as far as this quality is related to the workload.

As a method disadvantage, we can point out the only one parameter usage - that is the subjective feeling of the participants. Small number of participants in the survey also affects measurement accuracy. Including more people can improve analysis and final results. There are no recommendations and methodologies for performing actions that would normalize the environment for information exchange.

The research period only allows a snapshot of the state for teams and people. The challenge is to measure the dynamics of this awareness, and it can be done periodically, automatically, and possibly as a resource planning improvement. It is also possible to add new parameters, such as information load on projects and individual tasks. Using such tools and regular measurement, better and optimal knowledge exchange can be achieved, which can reduce stress in teams and improve the quality of their work. It is interesting to study the correlation between decision effectiveness and information load, as well as whether and how this efficiency could be assessed based on collected IO data.

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