

COMMUNICATION PROBLEMS IN INFORMATION SYSTEM AND SOFTWARE DEVELOPMENT

Goran Bubaš, Željko Hutinski, Dragutin Kermek

University of Zagreb, Faculty of Organization and Informatics, Varaždin, Croatia
e-mail: {gubas|zhutinsk|dkermek}@foi.hr

A survey was performed on 227 information technology (IT) professionals to investigate communication problems related to information system (IS) and software development. As a result of data analyses a more precise estimate was possible of the level of communication problems associated with various segments of communication in IS and software development, as well as an identification of the origins of such problems. Highest degree of difficulty was found in relation to communication with clients / users that is predominantly caused by their lack of IS and IT related knowledge or experience.

Keywords: information system design, software engineering, communication, users, teamwork, education.

1. INTRODUCTION

Effective communication is viewed as an essential element in software engineering and information system development [13; 17; 22]. For instance, effective communication can increase the potential for knowledge sharing and creation, as well as reduce task and role ambiguity [16]. Accordingly, much importance is placed on *communication skills* in the education of information technology professionals [3; 14; 18; 21; 24; 26].

Non-technical skills, like people skills and problem solving skills, are considered almost as important as technical skills in the IT professional arena [5; 27]. More specifically, information system professionals could also benefit from *trust development skills* [2], *teamwork skills* [23], *human facilitator skills* [4], *change agency skills* [20], and *emancipator skills* [9].

After investigating the structure of *competence in communicative interaction* with clients / users [7], as well as various aspects of information technology related communication activities of IT professionals like *presenting*, *selling*, *promotion*, *education of clients / users*, and *teamwork* [6], the communication problems associated with the phases of IS and software development process were brought to focus of attention in this research. However, it must be noted that communication related issues regarding the phases of IS and software development have previously been investigated in a proposition for introducing trained technical communicators in that process [19], in an analysis of project communication from the metrics perspective [12], and in a review of specific factors that influence project communication and project success [11].

2. CLASSIFICATION OF COMMUNICATIONS ACTIVITIES

The most common phases of IS and software development are associated with activities of *analysis, design, coding, testing, and implementation*. For instance, when viewed as a life cycle, the major phases of an information system development would be [1, pp. 70-73]: (a) feasibility study, (b) system investigation, (c) system analysis, (d) system design, (e) implementation, and (f) review and maintenance.

However, when the activities related to IS and software development are observed from a *professional communications perspective*, more diverse sets or classes of activities could be distinguished:

- conceptualizing the preliminary proposal of the IS or software application(s);
- identifying specific requirements;
- preparing the presentation of the offer / concept;
- presenting the offer / concept of the IS or software applications;
- definition of the software development project plan;
- team member definition and task distribution;
- work on design and coding;
- optimization of the prototype IS or software application(s);
- testing at the site of the client / user;
- implementing at the site of the client / user.

Of course, for such specific activities, professional communication could be predominantly directed towards *clients / users*, or performed within the *expert team* that designs the system. Furthermore, some of those activities may not always be present or performed in the same sequence, as they were previously listed, in all cases of IS and software development. Still, such a list of communication relevant classes of activities could be used for a preliminary survey of communication problems in IS and software development.

The following rationale supports the proposed set of communication activities. First, preliminary business proposals are occasionally given to clients / users even before the needed IS or software is fully developed, or specified in detail. After obtaining preliminary client / user interest, the requirements could be more precisely investigated to prepare the final concept of the IS or software offered during an official presentation. A precise definition of the project plan could precede or succeed such a presentation as well as the definition of team members. After the work on design and coding, optimization of prototype (preliminary version) IS or software could be performed before it reaches the site of the client / user, while final testing and implementing usually takes place at the location of the client / user.

3. PROBLEM

The objective of this research was to perform an introductory investigation of some *typical communication circumstances* in IS and software development, as well as of the *intensity* and *causation* of communication problems in various segments of that process.

4. METHOD

A survey was used to investigate the intensity and causation of the problems that come forth in various segments of the communication process associated with IS and software development. The subjects in the survey were IT professionals engaged in activities of selling, managing, designing, implementing, and maintaining of information systems and/or software applications.

4.1. Instrument

The questionnaire used in the survey consisted of 6 demographic questions and 10 questions that asked for assessment of the degree of communication problem for a specific point / segment in communication during IS and software development. The rating was performed on a 0-5 point Lickert type scale ranging from *no problems / insignificant difficulties* (i.e. "0"), on the one side, to *great problems / notable difficulties* (i.e. "5"), on the other side of the scale. An open-ended question was used with each rating scale to collect data on the origin or cause of communication problem for that specific point in communication, as well as about the actors who are involved in creating the difficulty.

4.2. Respondents

The respondents in the survey were 227 Croatian IT professionals who predominantly held a degree in informatics / IS development, electrical engineering / computer science, and economy / business cybernetics. Most of the respondents were engaged in software engineering and information system design, and others were predominantly employed in managerial work, presentations and selling. On the average, the respondents had 9 years of work experience. Their work environments had 1-5000 employees, as well as 1-150 IT professionals (10 on the average).

4.3. Data analysis

Analyses of survey data were performed by standard statistical methods and exploratory factor analysis (principal components method with Varimax rotation), as well by classification of responses to open-ended questions.

5. RESULTS AND DISCUSSION

Three types of results were obtained from data analyses. First, average ratings of the degree of communication problem were obtained for each of the analyzed segments of communication during IS and software development. Then, an exploratory factor analysis was performed to investigate the basic structure of communicative interaction in that process. Finally, the predominant causes of communication problems were identified from the responses to open-ended questions in the survey.

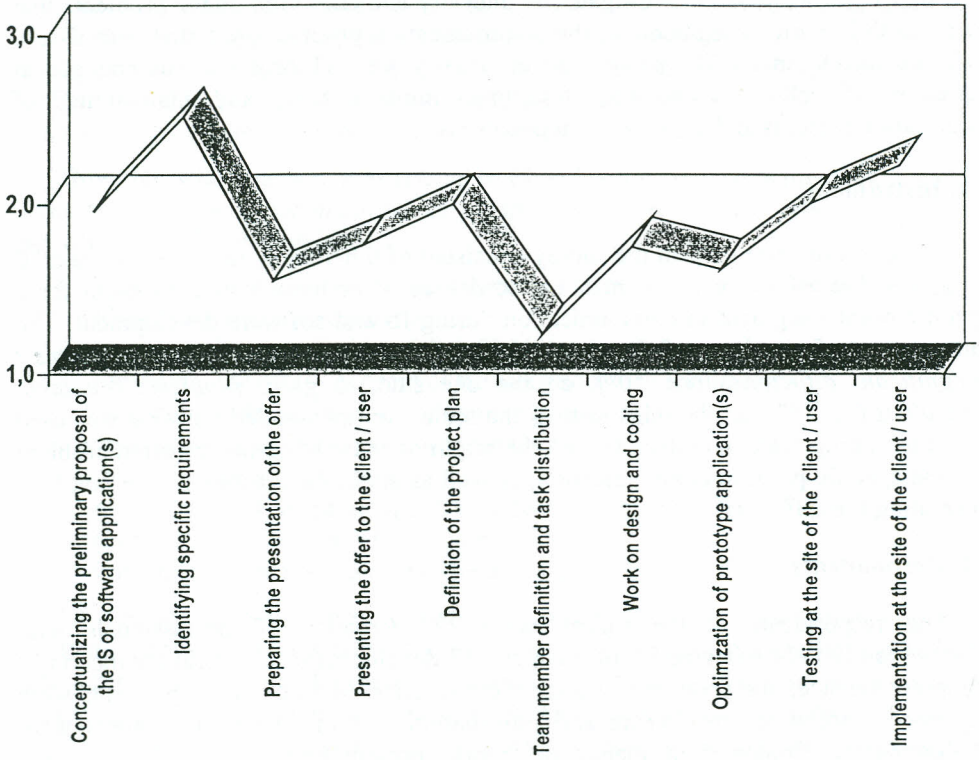


Figure 1. Average ratings of a degree of communication problems at various segments of communication during IS and software development

5.1. Average ratings of a degree of communication problems

The main results obtained by the analysis of ratings of a degree of communication problems for a specific point / segment in communication during IS and software development are presented in *Figure 1*. The highest average rating of a degree of communication problems was associated with *identifying specific requirements* when communicating with clients / users, as well as with the *implementation at the site of the client / user*. Also, the lowest degree of communication problems was associated with the *team member definition and task distribution*. In fact, somewhat higher degrees of communication problems were related to *communication activities with clients / users*. However, the *definition of the project plan* communication segment received a rather high average rating as well.

5.2. Factor analysis of ratings of the degree of communication problem

When exploratory factor analysis was performed on the ratings data to investigate the structural associations of communication problems in IS and software application

development, three factors were found that together explained 57% of the variance (each factor had eigenvalue greater than 1.0 and explained more than 10% of the variance). The uncovered factor structure is displayed in *Table 1*. Even though this structure is not fully transparent, it does outline the *three most general phases* in the composition of communication problems associated with IS and software development, i.e. the proposal-requirements-selling phase (*F1*), the organizing-design-coding or production phase (*F2*), and the optimization-testing-implementing phase (*F3*). It must also be emphasized that considerable projections of variables related to *preparing the presentation and presenting the offer* and the variable *team member definition and task distribution* on the third factor named *implementing* (*F3*), as displayed in *Figure 1*, could indicate that problems unresolved in the previous communication segments could negatively reflect on the interaction in this final phase in the structure of communication during IS and software development.

Table 1. Results of the exploratory factor analysis of the ratings of the degree of communication problem in different segments of communication during IS and software development

	F1 requirements	F2 production	F3 implementing
Conceptualizing the preliminary proposal	.67	-	-
Identifying specific requirements	.73	-	-
Preparing the presentation of the offer	.63	-	.43
Presenting the offer to the client / user	.48	-	.58
Definition of the project plan	-	.67	-
Team member definition and task distribution	-	.59	.37
Work on design and coding	-	.82	-
Optimization of prototype application(s)	-	-	.79
Testing at the site of the client / user	-	-	.66
Implementation at the site of the client / user	-	.34	.67

* Projections of variables that are most representative for each factor are written in boldface; factor loadings below 0.30 are not presented.

5.3. Causes of communication problems in IS and software development

After rating the degree of communication difficulty in relation to certain points / segments in communication during IS and software development, the respondents in the survey were asked to state the causes of communication problems, as well as the actor(s) who are commonly involved when communication problems occur. The results of the analyses of their responses are briefly presented for each communication segment with a comment on the average rating of a degree of communication problems presented in *Figure 1*.

- a) *Conceptualizing the preliminary proposal of the IS or software application(s)*. This segment received a moderately high average rating of the level of communication difficulty. The communication problems were mostly caused by *poorly defined necessities of clients / users*, as well as by their *lack of IT related knowledge and resistance to change*. Also, the IT professionals were characterized by insufficient domain knowledge together with an excessive use of technical terminology.
- b) *Identifying specific requirements*. The highest average rating of a degree of communication problems in IS and software development was found in relation to this segment of communication that involves customers / users in providing information about system requirements. More than 50% of the respondents rated difficulties in communication at this stage from *moderate to great / notable* (i.e. *in the range from 3 to 5* on a 0-5 point scale). Responses regarding the causes of difficulties were predominantly related to deficiencies in a *problem definition* like imprecision, incompleteness, misunderstanding, inferior problem assessment, unclear goals, and unawareness of complete necessities, where both the client / user and IT expert were involved. Other significant causes of difficulties were related to the already mentioned lack of IT knowledge and resistance to change on behalf of clients / users, as well as by the lack of domain knowledge by IT professionals.
- c) *Preparing the presentation of the offer / concept*. This stage was characterized by a rather low degree of average difficulty in communication. Also, there were very diverse types of responses concerning the causes of communication problems. However, most of them were related to *the business presentation aspect of communication* as, for instance, the possibility of not achieving satisfactory clarity and comprehensiveness, the inadequate selection of presentation content, the inappropriate proportion of time used for oral presentation versus software demonstration, the deficiency in adaptation to the audience profile etc. The difficulties were also related to obstacles connected with the client / user resistance to change, the lack of IT knowledge, and the inadequate problem definition.
- d) *Presenting the offer / concept of the IS or software application(s)*. A fairly low degree of difficulty at this point in communication during IS and software development is perhaps associated with the common atmosphere of presentational communication that is characterized by *formality and conciseness*. Still, the problem is caused by different levels of details in the presentation of the system that is wanted by various representatives of clients / users. Insufficiency of simple persuasive efforts succeeded by disproportionate technical elaboration were another source of difficulty, as well as poor adaptation to the IT knowledge level of clients / users.
- e) *Definition of the software development project plan*. Slightly more than 1/3 of the respondents rated the difficulties in communication at this point from *moderate to great / notable* (i.e. *in the range from 3 to 5* on a 0-5 point scale). Therefore, this segment in communication during IS and software development could be considered as having a moderate degree of communication problem. The identified causes of difficulties were mostly associated with the *shortage of time* and, especially, with problems concerning *deadlines*, whether they were unreasonable, indecisively set, disregarded, or not negotiable. Furthermore, problems were

associated with insufficient assessment and lack of information about the necessities of clients / users or *deficits in requirements specification*, along with the *unclear vision of the integrated system as a whole*. Conceptual differences among team members were also noticed as a source of problem, as well as deficiency of team members either in number or qualification.

- f) *Team member definition and task distribution*. This was the point with the least average difficulty in communication during IS and software development. The predominant causes of potential problems were related to the *shortage of IS and software experts* and also to their *work overload*, particularly of those with greater expertise. Other problems were associated with *managers who had insufficient insight into competencies of individual IT workers*, as well as with *their inclination towards inadequate task distribution that overlooked individual specialization, interest, affinity, and availability of team members*. Additional problems were connected with lack of problem domain specialists and difficulties in coordinating / organizing people and tasks.
- g) *Work on design and coding*. This stage received a somewhat lower degree of average estimate of difficulty in communication. The predominant problem was related to *deadlines* that were either set too close, inadequately estimated, or uncoordinated. Other communication problems were associated with *improperly defined tasks and objectives*. Dissonance among team members, confrontation over different concepts, inadequate interpersonal relations, lack of team spirit, and *deficient team communication* were also noted as sources of communication problems. Finally, supplements to the original design once the coding process had started, as well as incompatibility of different programmed modules were mentioned as well.
- h) *Optimization of the prototype IS or software application(s)*. A rather low degree of average estimate of communication problems was found also at this stage. The existing difficulties were caused mostly by *noncompliance with deadlines, delays in software completion, and lack of time*. Other sources of difficulty were related to the *additional requests for changes in requirements specification* (sometimes at the last moment), vagueness in project definition, disorganized and insufficiently specified (sometimes unreasonable) demands from clients / users, and also to lack of cooperation and poor feedback from clients / users.
- i) *Testing at the site of the client / user*. This stage in communication during IS and software development had a moderately high average rating of communication difficulty. The causes of problem were predominantly associated with the *resistance to change and novel IT technology*, as well as with the *unsatisfactory IT related knowledge and skills of clients / users*. Inadequate or insufficient test data for evaluation of the system, as well as the lack of time to perform the testing were also identified as causes of difficulty. Poorly defined requests, additional requirements, unreasonable expectations, deficient cooperation, contrasting "tastes" for various features of the user interface, and different interpretations of earlier agreements were specified as a further source of communication problems between IT specialists and clients / users.

j) *Implementing at the site of the client / user.* A rather high average rating of communication difficulty was found at this conclusive point of communication during IS and software development. In fact, about 45% of the respondents rated the difficulties in communication at this stage from *moderate to great / notable* (i.e. *in the range from 3 to 5* on a 0-5 point scale). Most communication problems concerning the implementation process were caused by the *resistance to change and fear of IT*, together with the *lack of familiarity with IT that negatively affects its utilization*, and the *ineffective participation of clients / users in training* that is performed to facilitate adoption of IT.

Numerous causes or origins of communication problems that appear at various stages of IS and software development were identified in this survey. Some of them are related to the *communication with clients / users*, while others appear in the *interaction among members of project teams and their superiors*. Perhaps the most prevalent cause of communication difficulty is lack of IT related knowledge that characterizes clients / users and their resistance to change in their work environment that is brought forth by the introduction of novel technology [see also: 6]. In addition, when IT specialists are taken into account, the communication problems are most often caused by deficiency in requirements specification, improper planning, and time pressure.

6. CONCLUSION

Professional communication in the process of IS and software development involves *different parties* that are engaged in designing, producing and utilizing complex systems. Communication problems that arise at such endeavors may significantly affect their outcomes. Therefore, insights into typical causes of those problems could be an important component of their resolution.

In concordance with the findings that communicative interaction is most frequent in the initial and final stages of software development [see: 12], the highest degrees of communication problems were found to exist in (a) the *requirements specification* phase and (b) the *implementation* phase of communication during IS and software development (see *Figure 1*). In both phases clients / users are very much involved in the communication process and the knowledge gap between them and IT professionals (regarding IT and the problem domain) is the main source of difficulty.

Furthermore, there are indices that communication problems are structured in three global domains or communication stages / environments that were named *requirements* (F1), *production* (F2), and *implementing* (F3), as illustrated by the results of factor analysis in *Table 1*. These environments are quite diverse concerning their temporal, spatial, social and problem attributes. Still, communication problems that are unresolved in a preceding stage / environment are probably reflected in the succeeding stage(s).

Finally, *numerous causes of communication problems were identified* by the analyses of responses to open-ended questions in our survey. They are relevant for *communication with clients / users*, as well as *intra-team communication and project*

management. Both *information technology professionals* (especially team leaders and project managers) and *educators* of future IS and software developers could make use of such data to improve their communication practices. Therefore, further studies should investigate those problems and possible solutions.

IT professionals are increasingly required to interact closely both with *technologists and non-technical users* [13] and quality of their communication considerably affects *client / user satisfaction* [25], as well as *team performance* [16]. Results of this survey indicate that education of IT professionals should be more focused on *project communication and experience* [see also: 15], but not with an emphasis on written and oral communication skills alone [e.g. 26]. In fact, multiple non-technical capabilities are considered to be important to IS professionals that enable more *effective communication, interpersonal relations, problem solving, and management* [10]. Considering the diversity of communication problems identified in our survey, more advanced communication skills and practices and, perhaps, even the selection of IT personnel on the basis of their communication related skills and traits [8] are very much needed since effectiveness of their communicative performance could greatly affect the successfulness of IS and software development projects.

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Goran Bubaš
Željko Hutinski
Dragutin Kermek

KOMUNIKACIJSKI PROBLEMI U RAZVOJU INFORMACIJSKIH SUSTAVA I PROGRAMSKIH APLIKACIJA

Sažetak

U istraživanju komunikacijskih problema koji su povezani s razvojem informacijskih sustava i programskih aplikacija provedeno je anketno istraživanje na 227 stručnjaka za informacijske tehnologije (IT). Na osnovi obrade anketnih podataka dobivena je preciznija procjena razine komunikacijskih problema vezanih za različite segmente procesa komunikacije prilikom razvoja informacijskih sustava i programskih aplikacija, a utvrđeni su i mnogi uzroci takvih problema. Najveća razina poteškoća utvrđena je u odnosu na komunikaciju s klijentima / korisnicima, što je većinom uvjetovano njihovim nedostatnim znanjem i iskustvom u odnosu na informacijske sustave i informacijsku tehnologiju.

Ključne riječi: razvoj informacijskih sustava, programsko inženjerstvo, komunikacija, korisnici, timski rad, edukacija.