FACTORS INFLUENCING THE GAP BETWEEN USER-DESIGNER PERCEPTIONS OF THE SYSTEMS ANALYSIS PROCESS

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ABSTRACT

Users and systems developers are anticipated to form different perceptions about the nature and effectiveness of their interactions during the process of systems analysis and design. This research examines factors associated with differences in user-designer perceptions about the effectiveness of their analysis interactions. The three dimensions of effectiveness of the analysis interactions used in the research were perceptions about the quality of user-designer interactions, effectiveness of consensus management, and user acceptance of design specifications. The influence of four factors - project characteristics, thoroughness of analysis of project objectives, quality of prior user-designer relationships, and the nature of the analysis methodology used on the perceptions about the quality of user designer interactions - was examined by drawing data on 94 user-designer pairs of respondents from a sample of 57 projects. Results indicate that the extent to which the project team of users and designer invest effort up front in analyzing the project's objectives has a significant influence on narrowing the gap in user-designer perceptions about the effectiveness of their analysis interactions. Implications of these findings for practice and research are discussed.

INTRODUCTION

Systems analysis is considered to be one of the crucial front-end activities in the development of organizational information systems. The systems analysis process is a knowledge-intensive effort, with relevant development knowledge on the proposed application thinly spread across an organization. Therefore, the analysis process must facilitate the acquisition, sharing, and integration of diverse perspectives from a multitude of stakeholders [6]. It is appropriate to view the analysis process as one of interactions among designers and users, where participants exchange their views and expectations about the proposed system and attempt to synthesize this information into a consistent set of analysis specifications.

However, users and designers often bring quite different frames of understanding and expectations with their participation in the analysis process [7] [8]. Thirty years ago, Churchman and Schainblatt [4] highlighted the importance of developing a mutual understanding between generalists and specialists while managing the implementation of information systems in organizations. DeBrabander and Thiers termed the problem resulting from differences in perspectives as semantic gap, which refers to the fact that "different persons have different concepts about reality [8, pg. 142)." They argued that semantic gap is a major barrier to the effectiveness of the development process. The existence of semantic gap has two potential implications: (i) knowledge integration during systems analysis could become blocked by the existence of a wide diversity of perspectives among users and designers, and (ii) users and designers might develop quite different perceptions about the effectiveness of the analysis process, the nature of their participation in the process, and the quality of the product emerging from the analysis [11] [19].

The goal of this research is to examine factors associated with differences in user-designer perceptions about effectiveness of their analysis interactions. Specifically, the research question addressed is:

How do various project-related factors influence the magnitude of differences in user and designer perceptions about the quality and effectiveness of their interactions during the analysis process?

Conceptual Model for this Research

The systems analysis process can be viewed as an arena for task-related and social interactions among the users and designers working on a proposed application development project [14]. Task-related interactions refer to the exchange of technical, work process, and organizational information relevant for the application system, while social interactions refer to communication, negotiation, and other interpersonal aspects of interactions among users and designers. Figure 1 presents the conceptual model that identifies the factors that we believe influence user and designer perceptions on the analysis interaction process. Elements of the model are elaborated below in greater detail.

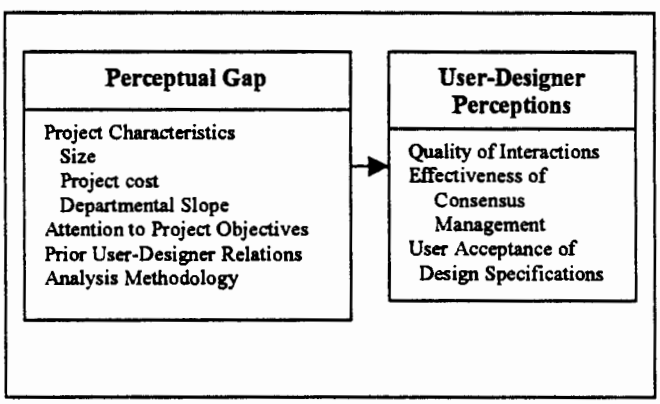

Figure 1. Factors Influencing the Gap Between User-designer Perceptions of the Systems Analysis Process

User-designer Perceptions of the Analysis Interaction Process

Interactions among users and designers occur through episodes of communication, negotiation, and consensus-building [6]. Our model identifies three important perceptual determinants of the effectiveness of the analysis interaction process: quality of user-designer interactions, effectiveness of consensus management, and user acceptance of design specifications.

The *quality of user-designer interactions* refers to the extent to which the analysis process facilitates conditions necessary for the participants to articulate their views and expectations about the proposed system, and synthesize their collective expectations into design specifications. Such conditions include active user/designer participation, open and frank communication, user influence in the design process, user commitment to sharing information and knowledge, and a feeling of partnership between the users and designers during the design process. These conditions allow the users and designers to communicate their knowledge and views about the proposed system and revise their understanding through exposure to others ideas and perceptions.

The *effectiveness of consensus management* refers to the ability to build agreement on the design specifications in a constructive manner. Effective consensus management is associated with actions that surface underlying disagreements, facilitate negotiations among the participants, and nurture constructive integration and compromises around viewpoints [2] [15]. The eruption of counterproductive conflict and political manipulation can hamper the ability of designers and users to engage in open and honest communication, learn from exposure to alternative perspectives, and negotiate differences toward a shared view of the design specifications [2] [15]. Therefore, the effectiveness of consensus management tracks the users' and designers' success in arriving at negotiated agreements on design specifications without resorting to nonproductive conflict management behaviors.

Finally, *user acceptance of the design specifications* is a consequence of the degree to which the users and designers are able to synthesize initial expectations into collectively acceptable design specifications. When the interaction process is managed in a way that individual members' opinions are not stifled and group cohesiveness is built and maintained, users should have favorable perceptions about the design specifications, perceive their overall objectives as being met by the design, and be more satisfied with the design specifications.

This research evaluates the sources of differences in users' and designers' perceptions about the effectiveness of their interaction process. Users and designers can form quite different perceptions about the nature of their systems analysis and design interactions [7] [8], which we refer to as *gaps in user-designer perceptions.*

Gaps in user-designer perceptions could have serious implications on the eventual success of the systems analysis effort and future user-designer relationships. Two different scenarios are possible. In the first scenario, designers could perceive that their interaction process was effective in facilitating the communication of user expectations and synthesis of these expectations into acceptable design

specifications. The users, however, have perceived the interaction process to be inadequate. This gap in perceptions could seriously inhibit users' commitment toward the project and interactions between themselves and systems analysts on future projects.

In the other scenario, designers could perceive that the analysis interaction process was not effective in facilitating communication of user expectations and synthesis of the design specifications, while users perceive the process to have been effective. In this scenario, designers might expend more time and energy than necessary to achieve communication and synthesis, or discard the current analysis interaction practices on future projects. Such actions could alienate users who might have perceived the original process to be effective.

In either case, it is important to minimize the magnitude of the gap in user-designer perceptions about effectiveness of their interactions during the systems analysis process.

Factors influencing gaps in user-designer perceptions

Four factors are believed to be important in influencing the magnitude of the gap in user-designer perceptions: project characteristics, extent of analysis of project goals, nature of the prior user-designer relations, and the analysis methodology used. These elements are discussed below.

Project Characteristics. The characteristics of applications development projects in organizations dictate the magnitude of knowledge integration, communication, coordination, and consensus building challenges faced by the project participants [12] [20]. The project management literature identifies three key project characteristics as significant influences on the gap in user-designer perceptions: *project staff size*, *development cost*, and *departmental scope*.

Many application development projects are too large for an individual or a small group to understand, let alone develop [12]. Estimation tools, such as ESTIMACS and COCOMO, consider project size characteristics such as *staff size*, *development cost*, and the *number of departments approving the proposed application*, in the development of estimates of resources required for a project. Projects characterized by larger size (staff days and development cost) require more communication and coordination and face greater levels of uncertainty and equivocality [12]. As the number of participants increases, the difficulties in developing a shared perception about the process and outcomes also increase [13]. Therefore, we anticipate that increasing project size and development cost should increase the gap in user-designer perceptions about the effectiveness of their analysis interactions.

Research on managerial cognition suggests that departments and units in organizations condition their managers to develop unique frames of thinking and evaluation about key initiatives and changes affecting their activities [21][22]. As a result, in the context of proposed information systems projects, managers from different departments might utilize different "thought worlds" [9] and apply the resulting interpretive schemes to form different opinions and expectations about the specifications of the proposed system.

Based on these arguments, we propose that:

P1a: *The gap between user and designer perceptions about the analysis interaction process will be greater for projects that are characterized by greater size (staff size, development cost).*

P1b: *The gap between user and designer perceptions about the analysis interaction process will be greater for projects that receive approval from a larger number of departments outside the IS department.*

Analysis of Project Objectives. Analysis of project objectives refers to the effort expended in understanding and clarifying the goals of the proposed project, prior to commencing analysis and design activities. More analysis is expected to lead to a better clarification of the project's objectives and permits the establishment of the project's boundaries and scope. Clarity in the definition of project objectives has been found to be an important success factor across all the stages of systems development, and has been recognized to be one of the core principles of effective project management [16] [18]. Clear project objectives provide the foundation for focusing and guiding the project efforts, against which changes or deviations can be monitored and controlled [17]. The absence of a thorough analysis of project objectives leaves room for project members and stakeholders to assume project objectives that meet their expectations and agendas, leading to more disparate perceptions about the effectiveness of their interaction process [17]. Therefore it is proposed that:

P2: *The gap between user and designer perceptions about the analysis interaction process will be narrower for projects that are characterized by greater thoroughness of analysis of objectives.*

Prior User-Designer Relations. Often, users and designers have established relationships forged through years of working together on other projects. These prior relationships are believed to set the tone for future

interactions. Prior relationships influence the degree to which users and designers might have developed trusting relations with each other. Further, they also influence the emergence of shared norms, values, methods of engaging in analysis interactions, and approaches to processing requirements information. Carlson and Zmud [3] suggest that prior relations and interaction experiences enable collaborators to develop a better ability to deal with ambiguous and conflicting information and move effectively toward convergence on future interactions. Therefore, when users and designers have a good working relationship prior to the systems development project, we anticipate that they will experience a smaller gap in their perceptions of the analysis process. Based on these ideas, we propose that:

P3: *The gap between user and designer perceptions on the analysis interaction process will be narrower for projects that are characterized by good prior working relationships between the users and designers.*

System Analysis Methodology. An IS development methodology is "a systematic approach to conducting at least one complete phase (e.g. analysis, design, testing) of software production, consisting of a set of guidelines, activities, techniques and tools, based on a particular philosophy of system development and the target system [24, p. 182]." User-designer interactions with the traditional IS methodology mainly use *one-on-one interviews* between users and designers during analysis. This limits user participation to a consultative role, with the bulk of the analysis and design decisions being made by the designer. During the one-on-one meetings, the designer attempts to understand critical work flows, factors that influence the operations of the system, and the key documents, procedures, and policies that comprise the system. As designers attempt to construct design specifications from the volume of information gathered during these interviews, they are placed at the center of conflicting requirements and have to develop design specifications that reflect a consensual viewpoint. Critics point out that the traditional process is hampered by problems such as slow communication, long feedback time, and a we-versus-they gap among users and designers who may be sheltered in their own environments [1] [23].

Joint application design (JAD) is an alternative analysis methodology that has recently received prominent attention [1][23]. The JAD methodology expands the scope of user involvement to a representative role, where users are collectively involved in articulating, negotiating, and developing the systems specifications [1] [23]. User participation in the analysis process occurs through group meetings that employ a structured agenda, techniques for effective management of group dynamics, and facilitators for managing creativity and conflict resolution among participants. These meetings become the key event around which the rest of the systems analysis and design activities revolve [1] [23]. Users and designers are collectively involved in the elicitation of expectations and negotiation of collectively acceptable design specifications and participate in the evolution of the systems design. The approach is believed to facilitate the social process of systems analysis by exposing individual participants to ideas and proposals posed by other participants. Studies have indicated that groups are more effective at negotiating conflict through the use of structured group techniques, process facilitation, and an agenda which are tools of JAD [23].

The preceding discussion suggests that different sets of analysis interaction dynamics occur with the traditional and the JAD analysis methodologies. Therefore, we anticipate that:

P4: *The gap between user and designer perceptions about the analysis interaction process will be greater for projects that use the traditional analysis methodology than the JAD methodology.*

RESEARCH METHOD

Data for the study were gathered through a survey as part of a larger project aimed at understanding the relative effects of the traditional and JAD analysis methodologies on the quality of systems development processes. The research project employed a purposive sampling strategy to select projects that had used either JAD or traditional analysis methods.

Senior IS executives at a sample of 100 firms representing utilities, transportation, insurance, and state government agencies were contacted and apprised of the study's objectives. Executives were asked to identify a list of systems development projects that had been completed within the last six months, regardless of their success or failure and contact information on the project leaders for the projects.

The project managers were contacted to solicit their participation, and were mailed a questionnaire to gather data about the project characteristics. The project managers were given concise definitions of JAD and traditional analysis methods and asked to categorize the method used on their project. The project managers were also asked to identify pairs of users and designers that were key participants in the applications projects described by them. Detailed cues on the activities and responsibilities of key users and designers were given to the project manager

to identify appropriate team members as respondents. These users and designers were mailed a separate questionnaire under a cover letter encouraging their participation and guaranteeing their anonymity. In all, data were gathered on 94 pairs of user-designers on 57 projects to achieve a response rate of 42 percent. About thirty percent of the projects involved responses from two or more pairs of user and designer respondents.

In order to verify the validity of these measures, the user and designer responses were separately factor analyzed through a principal components analysis and a varimax rotation method. The resulting factor structures from analyses of the user and designer responses were similar in that the same sets of items loaded together in the two analyses. Table 1 displays the results of the factor analysis on designer responses. All of the factor loadings except one are in excess of .60, and the internal consistencies measured through the Cronbach's alpha are above .80. These results provide adequate evidence about the suitability of the items for measuring the user and designer perceptions of the interaction process.

Quality of user-designer interactions (Cronbach's alpha=.87)	
The analysis process encouraged active participation	.81
Overall, communication during the analysis process was good between the users and IS designers	.82
In general, the analysis process assisted the users in developing a good understanding of the system while it was being designed	.72
In general, the analysis process promoted a feeling of partnership between the users and the IS designers	.62
The users were influential in the analysis process	.73
Effectiveness of consensus management (Cronbach's alpha=.81) (reverse scored)	
The analysis process created counterproductive conflict between the users and IS designers	.78
The analysis process promulgated politics between the IS designers and users that hindered the analysis effort	.78
User acceptance of the design specifications (Cronbach's alpha=.81)	
There was a high level of user acceptance for the system design	.86
Overall, the users were satisfied with the system design	.89

Table 1. Measures for Perceptions about the Effectiveness of the Analysis Interaction Process

Scores on individual items were aggregated to develop separate measures of user and designer perceptions on the quality of user-designer interactions, effectiveness of consensus management, and user acceptance of the design specifications. The gap in perceptions was computed for each matched pair of user-designer responses resulting in 94 pairs of gaps in perceptions along the three dimensions. Gap scores were computed as the absolute differences between scores of user and designer perceptions. These scores were then aggregated at the project level resulting in 57 different gap scores.

ANALYSES AND RESULTS

Table 2 illustrates the demographics of the sample of projects examined in this study. Two-thirds of the projects were new systems development projects with nearly half approved by at least two departments. More than half of the projects were greater than 12 staff-months, while slightly less than half of the projects had development costs in excess of $500,000. Systems analysts and programmer/analysts provided the majority of designer responses, while user perceptions were obtained from either the end-users of the information systems or managers of the end-user function.

Table 3 displays summary statistics and provides evidence of adequate variance in the scores of the key variables.

Type of project		**Number of departments approving the budget**	
New system development	40	One	30
Upgrade to an existing system	10	Two to three	12
Acquisition of software package	4	Four to five	4
Other	3	More than 5	11
Project development cost		**Project size in staff-days**	
$ 10,001 - $ 100,000	16	60 or less (less than 3 staff-months)	2
$ 100,001 - $ 500,000	13	61 - 120 (3 to 6 staff-months)	6
$ 500,001 - $ 1,000,000	8	121 - 200 (6 to 12 staff-months)	14
$ 1,000,001 - $ 2,000,000	9	201 - 1,000 (12 to 60 staff-months)	28
greater than $ 2,000,000	2	over 1,000 (over 60 staff-months)	7
missing values	6		
		Respondent Characteristics	
Designers (N=94)		**Users** (N=94)	
Systems analyst	26	End user	59
Programmer/analyst	28	Manager of an end-user function	27
Project leader	24	Director	6
Development manager	10	Other ()	2
IS director	3		
Other ()	3		

Table 2. Demographics of the Projects and Respondents

Variable	Mean	Standard deviation	Range	Notes
1. Gap in perceptions: Quality of user-designer interactions	.77	.47	0 to 1.83	Gap = User perceptions - Designer perceptions Perceptions about quality of interactions measured on a five-point Likert scale
2. Gap in perceptions: Effectiveness of consensus management	1.12	.73	0 to 3.00	Gap = User perceptions - Designer perceptions Perceptions about effectiveness of consensus management measured on a five-point Likert scale
3. Gap in perceptions: User acceptance of design specifications	.78	.55	0 to 2.33	Gap = User perceptions - Designer perceptions Perceptions about user acceptance measured on a five-point Likert scale
4. Project characteristics: Project cost	3.04	1.30	1.00 to 6.00	Measured as the development cost (dollars) Responses gathered from project manager on a six point Likert scale as illustrated in Appendix A. Higher score indicates greater project cost.
5. Project characteristics: Project size	3.34	1.06	1.00 to 5.00	Measured as staff-days Responses gathered from project manager on a five point Likert scale as illustrated in Appendix A. Higher score indicates greater project size.
6. Project characteristics: Departmental scope	1.74	.90	1.00 to 4.00	Measured as the number of non-IS departments involved in the project approval. Responses gathered from systems designer on a four point Likert scale as illustrated in Appendix A. Higher score indicates greater departmental scope.
7. Attention to project goals	2.05	.74	1.00 to 4.00	Measured as the amount of attention to analysis of the project objectives. Responses gathered from systems designers on a five-point Likert scale Lower score indicates a more thorough
8. User-designer relations	2.20	.75	1.00 to 3.5	Measured as the quality of relationships prior to the beginning of the project Responses gathered from user on a five-point Likert scale.

Table 3. Summary Statistics on the Study Variables

Each regression model was developed through a panel of predictor variables, entered in the following order: project characteristics (project cost, project size, and departmental scope), analysis of project objectives, user-designer relations, and analysis methodology. The incremental contributions to R^2 and the significance of the t-statistics for the regression coefficients were used as two indicators of significant predictor effects. A significance level of .10 was used as the criterion for hypothesis testing, in view of relatively smaller sample size of projects for the study. Project characteristics were found to have a significant effect on the gap in user-designers perceptions on the quality of interactions. Project size in staff days was found to have significant effects as predicted by hypotheses P1a. Although the effects of departmental approval was significant as predicted in P1b, it was in the opposite direction. Projects with approval from more departments were found to exhibit smaller gaps in perceptions about the quality of interactions. No significant effects were found concerning project characteristics on gaps in user-designer perceptions on the effectiveness of consensus management or user acceptance of design specifications. While departmental scope exhibited a significant regression coefficient in the case of user acceptance of design specifications ($b=-.17$, $p<.05$), the incremental contribution to R^2 was not significant. Overall, we conclude that the data provide partial support for proposition P1a.

Proposition	Gap in perceptions about quality of user-designer interactions	Gap in perceptions about the effectiveness of consensus management	Gap in perceptions about user acceptance of design specifications
P1a: Gap in perceptions will be greater for projects with greater size (staff, development cost)	Strong support for the effects of project size	Not supported	Not supported
P1b: Gap in perceptions will be greater for projects that receive approval from a larger number of departments	Strongly supported in opposite direction	Weak support	Weak support
P2: Gap in perceptions will be smaller for projects characterized by greater thoroughness of analysis of objectives	Strongly supported	Strongly supported	Strongly supported
P3: Gap in perceptions will be smaller for projects characterized by good prior working relationships between users and designers	Not supported	Not supported	Not supported
P4: Gap in perceptions will be greater for projects that use the traditional analysis methodology than the JAD methodology	Not supported	Not supported	Not supported

Table 4. Summary of Results

Strong support was found for proposition P2. The extent to which the project teams analyzed their project goals prior to the commencement of analysis significantly reduced the gap in perceptions about quality of interactions, effectiveness of consensus management, and user acceptance of design specifications. No support was detected for the remaining two hypotheses on the effects of prior user-designer relations (P3) and analysis methodology (P4). Table 4 provides a summary of the results.

DISCUSSION AND CONCLUSION

Developing a mutual understanding between users and designers is one of the dominant concerns in the social processes involved in systems analysis activities. Gaps in perceptions between users and designers about the effectiveness of the analysis process could have negative impacts on the implementation of the system being developed.

Overall, the results provide evidence that the extent of attention devoted to analyzing the projects' objectives was a significant determinant of the gap in user-designer perceptions. Randolph and Posner [18] suggest that project objectives and goals should be very specific: "You want to be so specific and so clear that you could drop dead tomorrow and somebody else could pick up the written goal and know exactly what to do (p. 66)." When objectives are not mutually developed and understood by the entire project team, users and designers assume goals and objectives for the project that meet their particular set of needs for the proposed project. These divergent goals can become a wedge between the perceptions of users and designers about the effectiveness of their interactions during the analysis process.

Another important project characteristic influencing the gap in perceptions is the number of departments that have approved the project. Contrary to our proposition, the results suggest that gaining prior departmental approval from a diversity of organizational units reduces the gap in

user and designer perceptions on the effectiveness of the interactions during the analysis process. It appears that managers exercise their opportunity to resolve their differences in project objectives and attain a greater understanding about the projects that they approve. As greater numbers of departments evaluate the proposed project and approve of its scope and funding, members from those departments participate more enthusiastically in the project team. Under these conditions there is less room for divergence in opinions about the key issues and, consequently, lower gaps in perceptions about the interaction process.

The type of analysis methodology used on a project did not significantly explain the gap in user-designer perceptions. We had anticipated JAD would reduce the gap between users and designers perceptions. In fact, the gap in perceptions persisted, with users having lower perceptions of user-designer interactions using JAD than the traditional design methods.

We surmise that different dynamics underlie the gap in perceptions created by the systems development methodologies. From the designer's point of view, JAD is a superior method because it enables a designer to transfer some of the responsibility for communication and negotiation to the users involved in the JAD session. Using one-on-one interviews necessitates designers to shoulder the entire burden of resolving conflicts in stakeholder design specifications and filling in any missing design specifications.

Users could be disenchanted with JAD for several reasons. First, users could be uneasy with the added responsibility for communication and negotiation that they are given in JAD sessions. JAD sessions require users to confront differences in their expectations and collectively arrive at a shared view of the design specifications. This often requires conflict and compromise that users are not confronted with in using one-on-one interviews. Second, facilitators are more effective when they are perceived as unbiased participants in the JAD process [1] [23]. IS designers often facilitate JAD sessions, potentially jeopardizing their objectivity or at least the perception of objectivity. Third, JAD sessions require larger time commitments from users than one-on-one interviews. JAD sessions often require several half or whole day sessions with user involvement. Finally, the study found that IS designers were not comfortable facilitating JAD sessions. JAD requires skilled facilitation and experience with a variety of creativity and conflict management techniques to be effective. It is very possible that poor designer facilitation skills compromised the sessions from the users perspective. Obviously, these suppositions need testing through future research aimed at understanding the dynamics of user participation in the JAD design process.

Finally, the nature of prior user-designer relationships did not seem to influence the gap in perceptions on the quality of user-designer interactions. This suggests that previous experiences between IS designers and users may not fully spill over into present working relationships: previous bad experiences can be overcome with good experiences on the project at hand. Likewise, previously good working relationships can be suppressed by poor working relationships on the current project.

Limitations of the Research

This research employed a purposive sampling strategy to identify potential projects for this research. The limitation to this strategy might be selection bias in the results. However, it was deemed important to ensure that we gathered data on projects that used JAD and the traditional development approach. Our purposive sampling strategy enabled us to achieve this goal. Second, about 70% of the projects in our dataset consisted of single pairs of user-designer combinations. Ideally, it would have been preferable to secure responses from multiple user-designer pairs for each project. However, the logistics of the data gathering effort and the desire to ensure completed responses from a pair of users and designers, precluded us from gaining additional responses.

Implications for Managers

Given the importance of the gaps in the perceptions between users and designers of the design process, how do project teams minimize these gaps and their consequences? First, designers need to understand that gaps can exist. Designers not aware of the perceptual gaps in the design process will continue to design systems as in the past, unaware of the differences in their perceptions with those of the users. Designers need to understand that, in general, they tend to over estimate the users group's perceptions on the design process. Designers should explicitly ask users how they perceive the design process is progressing and be more open to signs that the users do not see interactions or conflict resolution in a positive light.

Second, a project should not be initiated until clear project objectives have been developed. Project objectives can be subdivided into two areas: product scope and project scope. Product scope refers to the features and functions that are to be included in the project deliverable. Project scope refers to the work that must be done in order to deliver a product with the specified features and functions [17]. Defining the project and product scope is crucial in project success. These components: "(1) improve the accuracy of cost, time and resource estimates, (2) define a baseline for performance measurement and control, and (3)

facilitate clear responsibility assignments [17, pg. 52]." Without explicitly defining the goals, the purpose of the project is left for interpretation by individual members who ultimately conform the project objectives to their agenda.

A useful tool for defining the project scope for systems development projects is the extended context diagram. This diagram defines the boundaries of the system and specifies what the system will and will not include. The diagram defines external entities that interact with the system as well as the data flows between the system and the external entities. External entities are people, departments, and systems outside the application and include interfaces to other systems that are often unidentified at the beginning of the project. The system is broken into subprocesses that provide enough definition to clearly specify what is included in the application [5].

A useful tool for defining product scope is the work breakdown structure. This is a deliverable-oriented grouping of project components that organizes and defines all the deliverables of the project. Project deliverables are subdivided into smaller, more manageable components until the deliverables are defined in sufficient detail to support the project activities of the project. Work not defined in the work breakdown structure is outside the scope of the project [17]. As with the extended context diagram, the work breakdown structure is often used to develop or confirm a common understanding of the project scope.

In conclusion, designers must be aware of the perceptions of the user's during the design process. Risk of the success of the system design exists when gaps in the perceptions between users and designers become too large. Guidelines offered are a first step in reducing the perceptual gaps between users and designers on the systems design process.

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