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CHALLENGES OF CROSS-FUNCTIONAL SOFTWARE DEVELOPMENT TEAMS: A CONCEPTUAL STUDY

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ABSTRACT

The inevitable perspectives and identities in cross-functional software development projects often appear to be problematic. This paper draws upon the extant literature and postulates a conceptual model that explains the major challenges that cross-functionality adds to software development teams. The proposed model adds to the emerging contingency perspective pertaining to the study of conflict in software development teams. It also provides a more nuanced view of the challenges that cross-functionality adds to group settings. Theoretical and practical implications are discussed.

Keywords: software development team, cross-functionality, cross-functional software development team, conflict, cross-functional team, cross-functional project

INTRODUCTION

Global competition in software development industry has heightened the need to rely on cross-functional teams that produce innovations in a timely manner. As a result, organizations place diverse professionals on software development teams as a means of (i) addressing market necessities, (ii) building upon the competencies that organizations have already established, and (iii) igniting creative sparks to discover new market opportunities [7,33]. Accordingly, software development is a natural industry for cross-functional teams, and even if an organization has not formally established cross-functional teams, technical communicators need to closely work with diverse functional units such as IT and business functional units [37].

Collaboration is, however, believed to be inherently problematic in cross-functional software development teams [18,33]. More specifically, significant challenges might be present in encouraging people with dis-

similar knowledge, background, and social identity to work collaboratively [8,21].

Despite much research at the team level, the cross-functional aspect of software development projects has not yet found sufficient attention and empirical testing. Moreover, the little that is known about this area is mainly based on the relationship between IT staff and business users [22]. The increased attention on the relationship between IT staff and business users has resulted in overlooking cross-functionality in software development projects [41,51]. Specifically, the extant literature has not adequately investigated the potential tension among different IT staff or different business users [9,33,52]. Therefore, this is an obvious need to shed light on the nature and consequences of cross-functionality in software development teams. Understanding and anticipating such consequences may be critical if organizations hope to manage diverse team members' backgrounds, expertise, and social identities successfully.

This paper advances our prior on the concept of cross-functionality in software development projects. This is achieved by integrating the extant literature on software

development teams and cross-functional project teams. The structure of the paper is organized as follows. Firstly, the paper begins by explaining the increasing use of cross-functional teams in the software development industry. It then provides a review of the literature on the benefits of employing cross-functional teams as well as the natural challenges that occur alongside the potential benefits. This is followed by a more detailed discussion on the introduced challenges in software development literature, alongside linking them to the cross-functional teams' literature. Based on the reviewed literature, a conceptual model is postulated. The model demonstrates a series of challenges that cross-functionality adds to software development project teams. The paper concludes by a discussion of the research and practical implications of the proposed model.

CROSS-FUNCTIONALITY IN SOFTWARE DEVELOPMENT TEAMS

Software development teams are established to conceptualize, design, develop, and implement software that support business processes and functions [29]. These teams operate in dynamic and knowledge-intensive environments in which knowledge sharing and integration are central to their effectiveness [9,48]. In addition, the required knowledge, skills, and expertise for software development projects are too broad and complex to reside in any individual developer. Therefore, software development projects require input from heterogeneous team members with a diverse range of knowledge, skills, and expertise [23,33].

This suggests the employment of scarce representatives and specialists from broad domains and across various functional units for establishing software development projects [37]. For example, in addition to different kinds of technical specialists and business stakeholders, strategists and brand specialists might need to work together to design and implement new systems [33]. Marchwinski and Mandziuk [37] explored the employment of cross-functional software development teams in a software development company; Attachmate-Cincinnati. According to their study, a typical cross-functional software development team at Attachmate-Cincinnati usually consists of eight to ten people including software developers, technical communicators, testers, customer supporters, and representatives from marketing, sales, and manufacturing. Marchwinski and Mandziuk [37] explained that technical communicators in such teams integrate the marketing message as well as the ideas of soft-

ware developers, test engineers, and customer support representatives. In other words, technical communicators naturally create cross-functional teams, though such teams might not be formally considered as a cross-functional in the organization.

The extant literature defines cross-functional teams as composed of individual representatives drawn from various functional units (e.g., departments, functional units, groups, organizations) who possess specialized knowledge and skills relevant to the completion of the project [6,12,24,57]. Cross-functional teams were first suggested for new product development projects, and for releasing products in less time and with friction than in previous product releases [37]. Cross-functional members have competing social identities and obligation that are due to their attachment to different subunits of the organization [12]. Cross-functional membership allows these teams cross departmental or functional boundaries, be capable of cutting through the bureaucratic red tape, and fasten the project completion [34,49]. In addition, innovation is believed to occur at the boundaries between disciplines and specializations [14]. With this background, throughout this study, cross-functional software development teams refer to temporary work-groups that are charged with the responsibility of completing a development project within a limited time frame; they consist of members with diverse backgrounds and expertise that are drawn from various functional units (e.g., departments, functional units, groups, organizations).

TWO SIDES OF CROSS-FUNCTIONALITY

There are several benefits in employing cross-functional teams including: cross-learning, allowing team members to see the entire development process, and promoting innovation and creativity [30,45]. Cross-functional teams also increase the likelihood of obtaining sufficient support from various stakeholders [15].

Prior empirical studies, however, point to mixed positive and negative consequences of cross-functional teams [5,20,35]. While the potential for producing innovative outcomes is high, the potential for conflict and stagnation could be even higher [33]. Cross-functional teams are likely to experience tension caused by diverse professional philosophies and competing goals from cross-functional representatives [57]. As a consequence, tension, conflict, and misunderstandings among functional units may win over cooperation, and threaten team members' commitment [2,17,50].

In the following sections, this paper introduces two major challenges that might arise from cross-functionality including: (i) lack of shared understanding and (ii) interdepartmental relations and political conflict. Each of these challenges is further discussed in the following sections, and it is linked with the cross-functional project literature.

Lack of Shared Understanding

The cross-functionally aspect of software development teams indicates the distribution of project knowledge across different cross-functional members [16,43]. In the absence of shared understanding and common knowledge, team members may experience task conflict over the course of the project [31]. Task conflict in this context is related to disagreements and contrasting perspectives and opinions pertaining to a particular task [10].

Nelson and Coopridge [41] maintain that the absence of shared understanding across teams of IT and business people can contribute to dysfunctional group dynamics such as the incomplete or inaccurate capture of users requirements, which is repeatedly claimed to contribute to many software development failures [9,53].

In a field study, Curtis et al. [9] discussed the use of large software development teams including a mix of IT professionals (e.g., designers and programmers) and organizational representatives ranging from managers to users. Curtis et al. [9] observed significant conflict regarding system requirements, which was due to the presence of various functional units within the team. Furthermore, user-involvement particularly in the participatory approach may give rise to conflicts among different groups of users or may cause continuous demand changes in the early stages of the development process [56].

Notably, the extant literature indicates that task conflict may have beneficial results on team outcomes depending on how free members feel to express task-related doubts and how collaboratively or contentiously these doubts are expressed [36]. Kraut and Streeter [31] observed a large amount of conflict in the design meetings of large software development projects. They particularly highlighted the existence of disagreements as the result of incompatible goals. However, the latter scholars stated that most of the conflict was dialectic or educational, and team members were learning from each other. In these circumstances, effective communication and social interactions can transform task conflict into innovation and better resolution on existing disagreements and conflict [45]. Therefore, task conflict can evidently foster an exchange of information, and it can create a deeper understanding of the pertaining task-related issues. However,

with the lack of proper communication and social interactions among team members, task conflict might lead into relationship conflicts [10,38]. Emotional conflict pertains to incompatibilities between different personalities, and it is characterized by negative feelings such as tension and frustration [27]. It is important to note that social interactions do not always have positive impacts. For example, such interactions are believed to amplify the beneficial effects of task conflict as well as the harmful effects of relationship conflict [10].

The extant literature also asserts the moderating impact of ‘task complexity’ on the relationship between functional diversity and task & emotional conflicts [45]. More specifically, while task routiness reduces the positive associations between diversity and emotional conflict, it enhances the positive associations between diversity and task conflict. Pelled et al. [45] argue that routine tasks create less frustration than complex tasks. Therefore, individuals in groups performing routine tasks are less likely to displace frustration onto dissimilar others (task complexity-emotional conflict). In addition, individuals in group with routine tasks seek task debates with other members to make their work more accurate and even innovative (task complexity-task conflict). In addition, ‘group longevity’ appears to weaken the association between diversity and both types of conflicts. Specifically, after working together for a period of time, group members either develop a shared understanding of tasks or learn to anticipate and deflect opposition to their ideas [45]. In addition, the boundaries of social categories may become blurred after a while, and they begin developing a collective identity.

Figure 1 integrates the above discussions in a model. As shown, there are ten relationships in this figure. Firstly, lack of shared understanding generates task conflict among team members (1). The produced task conflict may have mixed impacts on group outcomes depending on the communication and social interactions among individuals. Specifically, Figure 1 suggests that task conflict has a direct positive impact on group outcomes (4), which is positively moderated by social interaction and communication (7). Task conflict may reach at a level that produces emotional conflict among individuals (2). However, its association with emotional conflict is negatively moderated with social interaction (8). In other words, the more social interaction and communication among individuals may inhibit the generation of emotional conflict out of task conflict. The model also suggests that emotional conflict has negative impacts on group outcomes (5), and social interaction may even increase its negative impacts through a moderating impact (6). In addition, individuals with emotional conflict may tend to criticize each other’s

works, thereby fostering task conflict (3). Finally, the model demonstrates the moderating impacts of ‘task com-

plexity’ and ‘group longevity’ on the relationship between functional diversity and conflict (9 and 10).

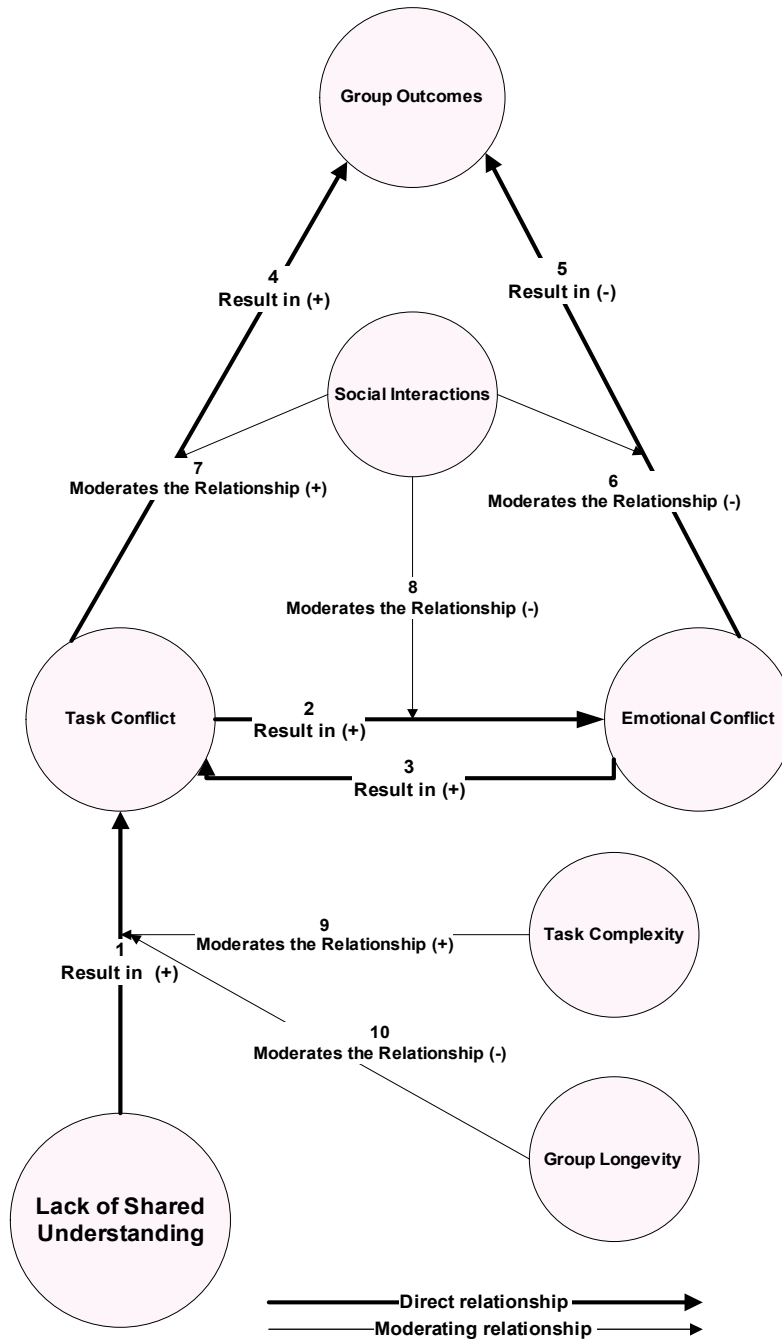


Figure 1: The First Challenge of Cross-Functionality in Software Development Teams

With these backgrounds, the next section explains the second challenge that cross-functionality adds to software development teams, namely interdepartmental relations and politics.

Interdepartmental Relations and Politics

There are a number of studies that point to the interdepartmental relations and politics as the result of competing goals and interdependencies among cross-functional software development members (e.g., [9,44]).

According to Nambisan and Wilemon [40], functional assignments of team members to software development projects make members owe too much allegiance to their functional groups. Members not only report to two bosses, but they also represent unique functional units and professional constituencies that often compete with the interests and goals of other units represented by other team members. Accordingly, members would tend to avoid making decisions that would be seen as unfavorable to their function, even if they are in the best interests of the team. Individual goals may even compete with those of the cross-functional team itself [57]. The above allegiance may lead to implications of treating knowledge as a private good among cross-functional team members, rather than the public good of the group [55].

The broad organizational categorizations and social identities in cross-functional teams make their climate ripe for arising political conflicts [10,32,42,45,46]. These factors can make cross-functional team members be identified more strongly with their functional unit, both socially and psychologically, than with their group and even the organization [30,46,47]. These identifications can provide fertile grounds for the occurrence of tension in cross-functional teams, and they are believed to be nearly always manifested in organizational politics [57]. The preponderance of literature acknowledges that political behaviors in the work setting lead to emotional conflict, stress, anxiety, and they can jeopardize goal achievement and the value of cross-functional projects [57]. The literature on team conflict has provided ample evidence that emotional conflict is negatively associated with group outcomes [11,32]. According to Jehn [25], emotional conflict among individuals reflects itself in interpersonal clashes among group members such as anger, frustration, and other negative feelings. Emotional conflict may prompt group members to criticize each other's ideas, thereby fostering task conflict. However, Jehn [25] and Pelled et al. [45] state that if members find ways to cope with those with whom they have emotional conflict (e.g., they choose to avoid working with those with whom they experience relationship troubles), the conflicts may be

manageable [26]. Other behavioral examples of workplace politics include withholding important information from other team members in order to weaken their ability to compete for scarce resources to accomplish goals outside of the charter of the team. Individuals in political situations tend to immerse themselves in their work, and thus they are unavailable to help others. These behaviors affect team effectiveness by reducing team cohesion and team member cooperation [46,57].

Moreover, different functional objectives, priorities, and agendas that could be often in conflict, make team members from different functional areas unable to exploit their diverse knowledge and expertise [39,47]. Pee et al. [44] empirically showed that different backgrounds, expertise, and project roles make the subgroups of business and IT professionals have different goals of their own in addition to the project goals. For example, positive goal interdependence makes them promote mutual goal attainment by coordinating and cooperating with each other. However, if conflict becomes a dominating concern, they may behave uncooperatively in order to prevent others from achieving their goal, since one's success is at the expense of others [13,28]. For example, users might desire adequate functions, whereas programmers might focus on overcoming technical constraints and enhancing competency of their careers, and project managers might like to ensure that milestones and budget expectations are met. Such aforementioned conflict indicates a considerable gap in user participation literature that is often silent on the potential negative effects of user participation, as well as the underlying mechanisms that cause it [4,22]. Similarly, IT professionals might experience similar challenges. For example, designers and coders might disagree on design methodology, programming language, database server and etc [54]. These types of conflict pertain themselves to task conflict, which can also be transformed to emotional conflict.

As a result of the above discussions, interdepartmental relations may result in both job-relatedness of diversity (task conflict) as well as the social segregation side of diversity (emotional conflict) [45]. In other words, it can be expected that interdepartmental relations and politics can produce both emotional and task conflicts (shown as links 11 and 12 in Figure 2). Apart from the links in Figure 1, the model in Figure 2 illustrates the moderating impacts of 'task complexity' and 'group longevity' in the relationship between diversity and emotional conflict (13 and 14). The rationale for these two links is similar to the ones for links 9 and 10 that were described in the previous section. Taken together, Figure 2 synthesizes the above propositions with the model presented in Figure 1.

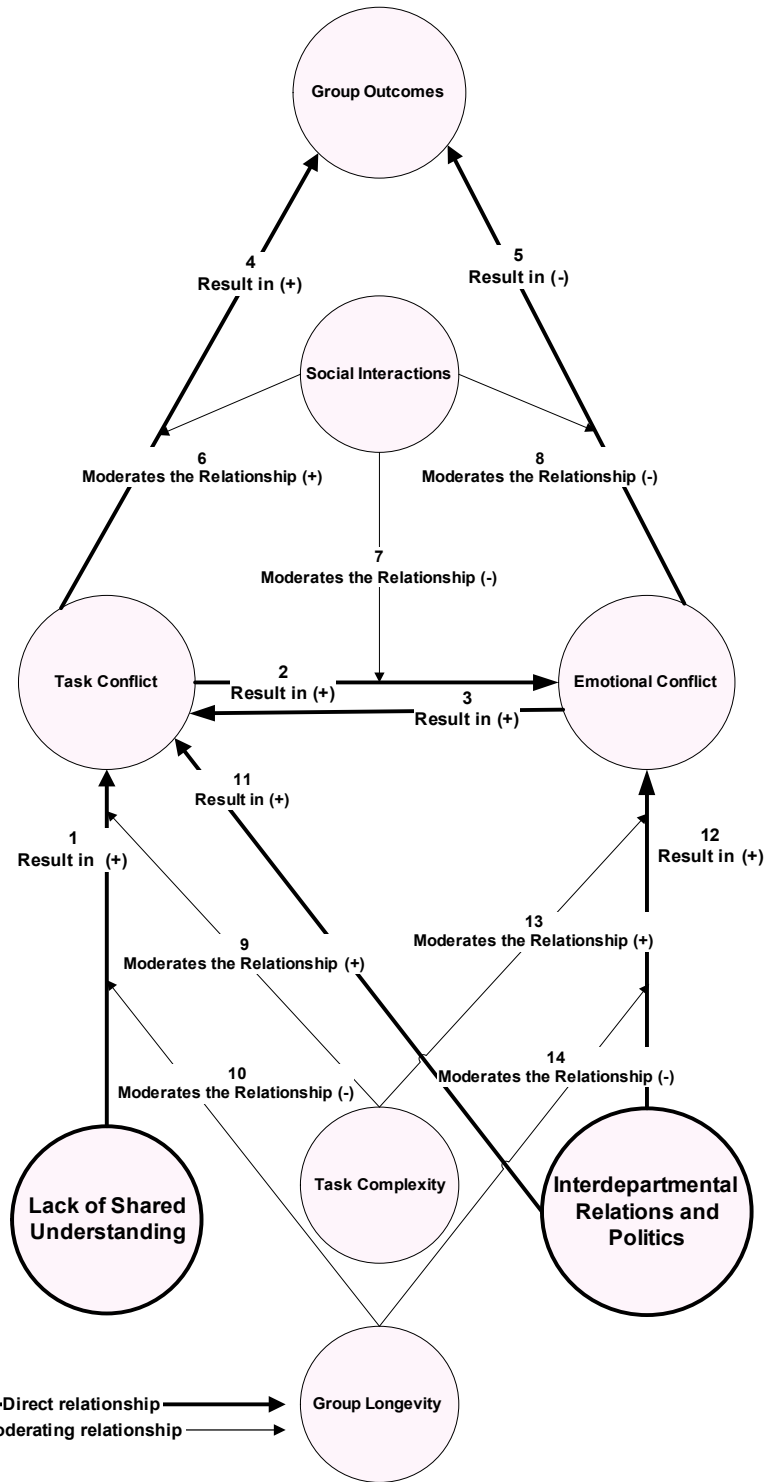


Figure 2: Two Challenges of Cross-Functionality in Software Development Teams

Majority of the extant literature has shown the negative impacts of competing goals on diminishing motivation and withdrawing commitment of team members. However, the results of Andres and Zmud [1] in software development teams do not concur with the this viewpoint. Their results are in alignment with another existing viewpoint toward competitive conflicts. This viewpoint suggests that competition could produce innovative results up to a certain level after which it becomes negative because of excessive duplication and coordination costs [3]. The above idea is in consistency with the model introduced by Xie et al. [58], which relates innovation success to cross-functional conflicts. The latter model suggests a concave relationship between new product development performance and the level of organizational conflict across different departments [58]. The model in Figure 2 can explain the above viewpoints. More specifically, cross-functionality can generate both task and emotional conflicts. If emotional conflict could be managed properly, task conflict alongside proper social interaction and effective communication can provide positive impacts on project outcomes.

DISCUSSION

The entrance of broad ranges of professionals into software development project settings adds to the challenges for establishing effective collaboration in these project teams [33]. Software development has been, however, usually studied from a lens of different expertise and lack of shared understanding among involved parties rather than a thorough investigation of the consequences of cross-functionality on project outcomes [9,52].

This study advances our understanding of a new, rapidly spreading phenomenon in software development industry, cross-functional teams. Specifically, this study integrated and synthesized two research streams (software development team and cross-functional project team) in order to better understand potential challenges that cross-functionality can bring to the context of software development teams. Driven from the reviewed literature, a model has been postulated. The proposed model is framed in terms of two major challenges including: (i) lack of shared understanding and (ii) interdepartmental relations and politics. The model explains how these two challenges may produce simultaneous positive and negative consequences. Accordingly, this study adds to the emerging contingency perspective pertaining to the study of conflict in system development teams, and it provides a more nuanced view of the challenges that cross-functionality adds to group settings. Overall, the proposed model offers insights for managing the link between cross-functionality

and work group functioning. The postulated model in this study is in consistency with the proposed models of prior research suggesting that cross-functionality has its potential positive and negative consequences through the communication and coordination patterns that occur among team members [36].

Cross-functional project literature suggests integrating diverse identities that people convey from different functions and replacing them with a sense of strong team identity [39]. Similarly, IS literature explains that development of collective identity and practices among team members is one of the prerequisites to effective collaboration [33]. For example, Levina [33] conceptualized collective identity as a representational resource that helps collaborators develop a sense of belonging by stressing similarities or shared attributes. The development of collective identity may, in turn, increase the sense of collective efficacy. Research has shown that strong sense of collective efficacy makes team members persist in the face of difficulty, and these teams are ultimately more likely to succeed compared to the groups who do not share this characteristic [19]. Therefore, directing groups to build a high level of collective efficacy as early as possible would be beneficial. However, it should be noted that with high levels of confidence at the early stages of a group's existence, team members are less likely to engage in task conflict, which may be beneficial in the early phase of a project [19].

Shedding some light on the challenges of cross-functionality in software development industry, research now needs to turn its attention to operationalizing the proposed conceptual model and developing measures for the constructs in the model. Future research studies are also welcomed to study different methods of facilitating effective communication among cross-functional software development team members. A focus on explicit boundary objects such as prototypes or shared IT applications in facilitating communication across boundaries is suggested [33]. The extant literature suggest that diverse groups face countervailing forces, such that some forms of diversity increase conflict and other forms (e.g., age) may do the reverse [45]. Thus, managers must be prepared to meet challenges presented by heterogeneity as well as homogeneity in their cross-functional teams. This study did not account for such items, yet such issues shall be considered in the formation of software development teams. The present study proposed the challenges of cross-functionality from a more general perspective. Another fruitful avenue for future research would be to link the present study's general perspective of conflicts to their more specific manifestations in different phases of development projects. One possible option would be investigat-

ing the complexity of different phases of system development, since they might manifest different conflict patterns.

CONCLUSION

Cross-functionality in software development literature is a neglected yet important topic. Our study indicates two major challenges that cross-functionality adds to software development project teams. The model suggests that these challenges generate mixed positive and negative results depending on the patterns of communication among team members. Consequently, information system researchers and practitioners need to direct greater effort toward balancing communication and interaction in software development teams.

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