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Information Elaboration and Coopetition: Participation in the Replacement of Legacy Systems

Jacob Chia-An Tsai, Gary Klein, Carol S. Saunders, and James J. Jiang

***Abstract*—Legacy information system (LIS) replacement projects are increasingly complex. Consequently, they require cooperation to integrate different functional knowledge to support organizational business processes. However, cooperation on cross-functional LIS replacement project teams face inherent competition for scarce resources and conflicting functional interests. The common assertion is to reduce or eliminate this competition. We suggest that the potential benefits of competition complement the known benefits of cooperation. Thus, this study explores the extent to which different configurations of simultaneous competition and cooperation (i.e., coopetition) enhance decision-making processes in the context of LIS replacement. Information elaboration theory guides decision-making in the coopetition–performance relationship. We propose a model that relates different patterns of coopetition, based on a two continua approach, to three information elaboration techniques and their impact on system design quality. We test the model using a survey administered to 161 pairs of matched IT executives and managerial leaders knowledgeable about LIS replacement. Analysis indicates that cooperation-centric coopetition (strong cooperation with some competition) best enhances decision-making processes and improves system design quality.**

***Index Terms*—Coopetition, information elaboration, legacy information systems (LIS), polynomial regression, replacement.**

I. Introduction

Conventional wisdom extols the virtues of cooperation in replacing legacy information systems (LIS) since functionally diverse participants retain knowledge required to design the replacement LIS [1], [2]. Cross-functional cooperation is required to leverage knowledge from the many functional disciplines [3]–[5]. Even though working for the same organization, conflict among the different functional groups exists due to competition for limited information system resources, localized habits, and incompatible goals [3]–[6]. Further difficulties arise in the LIS context because of the following:

1) the need to update business practices for all functional areas [7], [8];
2) limited documentation and domain knowledge to provide a comprehensive understanding of both old and new system requirements [7]–[9];
3) the need to reconcile disparate opinions and competing goals of the diverse functional groups [10], [11].

The design for LIS replacement requires effective team decision-making to foster cooperation among representatives of diverse functional areas and overcome the aforementioned hurdles [7], [12]. In response, the traditional focus of system development work is on cooperating to acquire requirements from cross-functional agents while minimizing conflict and competition [13]–[15].

However, dismissing competition's value in the design of an LIS might prove flawed. True, competition may result in harmful conflict or opportunism, and the LIS context is not exempt from potential harm [16]–[19]. The design of an LIS replacement involves participants with different functional goals, opening a pretext for posturing [20], [21]. Politics and interdependencies affect the distribution of organizational resources, exasperating any direct or indirect competition among the participants [22]. Direct competition would involve acquiring beneficial services in a limited resource environment and responding aggressively to competitive threats. Indirect competition, such as evading procedural change or promoting self-interests, is no less real and may create destructive conflict [23]. However, competition can improve creativity, identify more options, and offer a benchmark to motivate performance [24], [25]. Diversity in the design team (the core development team) arises from the interests of functional groups. While the diversity might lead to conflict, it might enhance decision-making processes through an added breadth of knowledge [26].

Therefore, designing an LIS replacement encourages a deeper look into the role of both cooperation and competition, especially given the natural bent toward competition among the functional areas about goals, resources, incompatible backgrounds, and hidden agendas [22], [27]–[31]. When cooperation and competition coexist, it is termed coopetition; coopetition is the situation where actors collectively create value through cooperation while competing to capture more value for their benefit [32], [33]. In this light, coopetition positively influences sharing

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knowledge, making decisions, and enhancing performance [34]–[37]. Coopetition is possible because participants who compete for resources and benefits share weak ties simultaneously as they share strong ties to cooperate and achieve organization-wide goals [33], [34], [38].

Few studies examine how coopetition should be configured, and most consider the simple presence or absence of a component (competition or cooperation) [25], [36], [39]. The one continuum logic of coopetition is that the degree of coopetition swings between the two poles of cooperation and competition [40], [41]. The degree of cooperation (competition) will restrict the development of competition (cooperation). We overcome that restriction by extending coopetition to two separate continua. The two continua logic of coopetition frees the restrictive assumption and views cooperation and competition as two different components that coexist. Therefore, groups in coopetition can simultaneously cooperate in one activity and compete with their counterparts in other activities [40], [41].

Configuring decision-making activities to capitalize on both cooperation and competition benefits is a managerial challenge [25], [39]. We ask, "*How should coopetition be configured to improve participation from diverse functional units in decision-making activities?*" We argue that the core team (comprised of representatives from diverse functions) must draw out competing perspectives and control attempts to monopolize limited internal resources, all while attaining the cooperation required to reach successful project completion [15], [22], [42]. We use multilevel information elaboration theory (IET) for the theoretical framework. IET focuses on information elaboration to mobilize knowledge resources, thus enhancing team performance, especially creativity, innovation, and decision quality [43], [44]. Information elaboration describes a strategy of adding information during decision-making processes to pursue comprehensive solutions, apply constructive debate, and integrate knowledge [43].

We evaluate how coopetition among core team members impacts decision-making processes designed to elaborate information to answer the research question. We build and test a theory-derived model with a sample of 161 LIS replacement projects. The distinct patterns of coopetition result in different information flows across functions and, thus, provide diverse knowledge for decisions. Our study contributes to the understanding of LIS replacement, and perhaps IS development in general, in that it 1) confirms and extends information elaboration theory as a common foundation for coopetition in system design decisions, and 2) provides new insights to specific techniques that enhance information elaboration. These findings lend a unifying theoretical perspective to the multiple LIS challenges related to participation and suggest guidelines for developing processes that capitalize on information elaboration benefits.

We first review the theoretical foundations of the study, synthesizing the coopetition literature to present the coopetition paradox by conceptualizing IET to identify decision-making processes linking coopetition and system design quality. Next, we detail the methodology used to collect and validate the data. After discussing empirical results, we provide implications for research and practice and recognize limitations.

II. Theoretical Background

A. *Information Elaboration in the Decision-Making Process*

IET treats groups as information processing systems [43]. Information elaboration is the central mechanism to utilize and mobilize knowledge resources from diverse groups to achieve a particular goal or make a collective decision [43], [44]. Ever more information augments knowledge about an object (e.g., a system design) until a satisfactory result is achieved. Design team members conduct activities to exchange, discuss, and consolidate dispersed information to achieve expected performance [43]. Four established properties of IET include the following:

1) knowledge differences among the team members that augment the knowledge of others;
2) a decision-making process;
3) expectations of complex tasks or products;
4) interdependence of goals or resources of team members [43].

The nature of LIS replacement involves a complex network of stakeholders or stakeholder groups with diverse and shared interests [20], [45]. Further complexity arises from changing situations associated with interactions among the LIS components and between the new system and its environments [7], [45]. The decision-making processes of IET involve aspects of collective cognition [43]. Team processes are vital to grasping diversity's potential because it is not the availability of information but the use of information in task performance that is the basis of superior performance [43]. Elaboration of task-relevant information underlies the positive effects of diversity on performance, both in the preparation of information and in the process of making informed decisions [44].

In particular, three decision-making techniques elaborate on available information and are essential to ensuring system success: comprehensiveness, constructive debate, and integrative solution [46], [47]. *Comprehensiveness* reflects the degree to which the team's decision-making process is extensive and exhaustive [46]. Devising possible alternatives and systematically considering positive or negative aspects are examples of decision comprehensiveness [44]. Extensive information can be gathered from different individuals' knowledge and perspectives, reflecting a practice of information elaboration adding to comprehensiveness [48]. Since decision-makers in business organizations differ according to their functions and professions, they often employ political tactics to ensure that their self-interests are reflected in the outcome [49]. In this connection, *constructive debate* incorporates task-related disputes and controversies [50]. Debate is an interaction where further information is drawn out and communicated to increase elaboration further [44]. To reach a satisfactory agreement, conflicts between opposing parties must be addressed [51]. An *integrative solution* refers to the extent to which team members apply available information and resources to construct solutions of mutual benefit [52]. Therefore, team members seek to maximize joint outcomes through solution-integrating behaviors requiring greater information about preferences, building alternatives, and defining problems [44]. IS development failures may result from insufficient integrative solutions among different stakeholder groups [45].

B. Coopetition: Cooperation and Competition

Though cross-functional participants cooperate in developing an IS, they also compete to protect functional interests and seek relative advantages. IS studies indicate coexistence of cooperation and competition among development team members and other stakeholders during system development and implementation [15]. This study suggests that optimal information elaboration requires an understanding of the interplay between cooperation and competition.

Formally, *cooperation* is defined as actively working together to achieve a common purpose [53]. In the team literature, cooperation is how a team positively interacts to implement processes, make decisions, and share knowledge and resources [53]. Complex interdependence (e.g., task or resources) among cross-functional participants creates a need for cooperation [54]. Organizational knowledge is fragmented across different functional departments; no single participant has the collective knowledge, knows what knowledge is available, understands where the needed knowledge resides, or knows how to access it to make the best decisions [55], [56]. Limiting teams to a single functional area to avoid such conflict is not viable. Linking interdependent functional members in different departments requires a high level of cooperation to ensure all team members contribute to common goals. Thus, a cooperative environment is essential to capitalize on cross-functional participants' diversity of knowledge and talent [54]. However, on its own, cooperation typically only draws out further information when plans go astray, falling into a form of complacency if no conflict arises [57], [58].

In contrast, *competition* in cross-functional teams results when members contend for limited resources or primacy of their views [53]. Under cooperation, team members believe that goals are positively correlated, while in a competitive structure, they believe goal achievements across functions are negatively correlated [50]. The IS literature provides a rich foundation of competitive behaviors [22]. High-level interunit conflict in IS development projects is inevitable because stakeholders have inconsistent preferred outcomes and different system requirements views [28]. Nevertheless, positive aspects of competition are also compelling in the literature and in line with the theory of information elaboration [59]. Competing views and diverse backgrounds stimulate discussion and new ideas [26], [59].

Coopetition occurs when cooperation and competition coexist [36], [60]. Cooperative ties are links to others characterized as having high interaction with affective contents and shared common interests. Competitive ties are links to others characterized by infrequent interaction or less affective content and private interests [33], [34]. Cooperative ties acquire relevant knowledge to produce a knowledge structure for a particular problem, enabling decision-makers to monitor the decision-making process regularly and obtain more advice on the problem [47], [61], [62]. Competitive ties provide broader or deeper knowledge of potential alternatives and the external environment, making

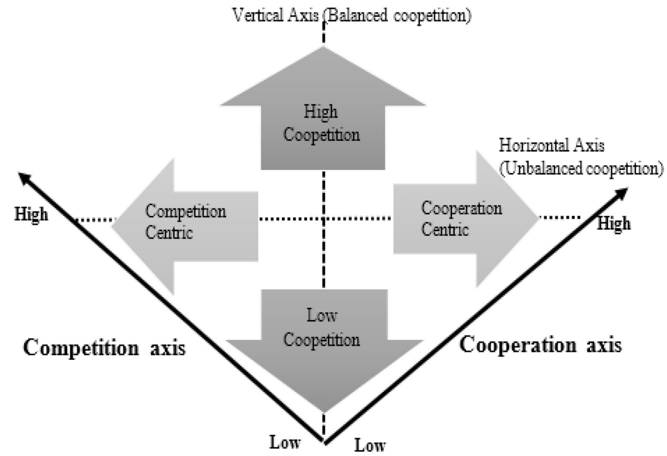

Fig. 1. Coopetition continua.

decision-makers aware of suitable alternatives that allow fitting to the changing environment [61], [62]. The core team must elicit knowledge to use in the decision process but be aware of benefits and consequences [63]. The elements of coopetition and the LIS context map to the properties of IET as summarized in Table I.

A coopetition paradox exists—cooperation encourages participants to pursue a collective goal, even as they pursue self-interest under the competition condition [37], [53], [64]. The coopetition paradox results from seeking a proper mixture of cooperation and competition [33], [60], [64]. Extremes exist. In a zero-sum competition, the outcome interdependence is strongly structured; the winner takes all the benefits. In a nonzero-sum game, likely the norm for LIS replacements, participants can cooperatively manage competition to produce a constructive outcome that satisfies the assemblage of participants [15], [28]. However, evidence of the proper mix is limited and inconclusive, especially in the intragroup situation [36]. Empirical evidence in strategic management studies indicates balanced coopetition at a high level (cooperation and completion both high) results in superior firm performance and innovation [41], [66]. On the other hand, a high coopetition balance increases tension levels and impedes performance [67], [68]. Fig. 1 shows this aspect of mixing cooperation and competition, with an equal balance along the vertical axis.

The premise of the coopetition continua is that one should accept the contradictory nature of the paradox and seek to create synergies from all possibilities. A synergistic approach often includes temporal or spatial separation of paradoxical elements, but both fail to recognize the value of coopetition because cooperation and competition must be constituted simultaneously [40], [41]. Moreover, a paradox cannot be broken down into dichotomous concepts between contradicting elements but must be considered a continuous process reflecting all possible dynamics [33], [41]. Given that deviations are suitable situations, Fig. 1 incorporates when coopetition leans more toward cooperation (cooperation centric) or more toward competition (competition centric) [41], [69].

Suppose a cross-functional team is not balanced. In that case, it will be competition-centric (where competition is more

TABLE I
IET PROPERTIES IN THE LIS AND COOPETITION CONTEXTS

IET properties	LIS replacement	Coopetition
Differences among members: IET aims to explain how the extent to which there are differences among members of a group affects group functioning [43], [44]. The differences provide group members with a larger pool of knowledge resources relevant to the group's task.	Knowledge-worker team: The governance structure of LIS replacement includes a diverse group of key stakeholders [45]. By having end-users, external experts, and cross-functional members, the replacement accesses operational knowledge from fragmented business processes to attain an understanding of the best design from best-practice knowledge.	Diversity: Conflict and competition will arise among the cross-functional units because of the diversity of available approaches, different backgrounds and experiences, goals, and different perspectives of the influential stakeholders [53].
Significant decision-making process involved: Elaboration is present as new task-relevant information beyond existing knowledge [43]. Group members carefully evaluate the information introduced by others to understand the implications for their area of expertise to achieve an optimal solution [44]. By elaborating on the information in group decision-making, the differences in perspectives and opinions can lead to an in-depth understanding of the task and higher quality decisions.	Participative decision-making: The knowledge of the legacy applications and business processes are distributed among different units [45]. All impacted units must rely on effective decision-making to integrate the different knowledge and opinions about the viability of system design. The system design is discussed, and the system features and functionality are determined by the team composed of cross-functional members that open the necessary channels for discussing new ideas [21].	Information processing: Coopetition is directed toward cross-functional units being responsive to one another to achieve common goals employing information processing that reflects mutual understanding [33], [53]. Information processing is one crucial component or prerequisite of decision-making [34].
Task complexity: Information elaboration is more effective when applied to group performance for complex tasks than for simple tasks [43]. The benefits of elaborate information processing are significant in complex, unstructured, and innovative team tasks.	Change: The LIS replacement often involves critical changes to IT infrastructure and organizational structures that affect multiple subsystems, business processes, and functional units [45]. The replacement commits to a wide range of subsystem modernization that presents significant risks and complexity [20].	Paradox: The contradictory logic of cooperative and competitive interactions between the cross-functional representatives results in a paradoxical phenomenon [41, 65]. The cross-functional units must manage this paradox of logic.
Interdependence among members: Information elaboration requires the investment of collective effort in considering group members' perspectives to achieve the goals [44]. Members must have shared responsibilities for elaborating information and bringing together various points of view.	Interdependence: Successful LIS replacement is when all the affected units can successfully use the system to support their current products and services [11]. The core team has well-defined responsibilities to achieve this task. Each member from the functional units is responsible for their area and held accountable for achieving the objectives of the LIS replacement project [7].	Interdependence: The cross-functional representatives cannot play a zero-sum game reflecting their interests because they have an interdependent structure within the organization [45].

pronounced than cooperation) or cooperation-centric (where cooperation is more pronounced than competition). Competition-centric allows self-interest among group members that may not suit the best interests of the whole but may surface high creativity or other benefits of diverse knowledge [40]. Cooperation-centric actions attain common goals essential for advancing development while possibly suffering from lower creativity or other detrimental consequences of blind cooperation [40]. This two-dimensional continuum allows assessing the impact of various mixtures [40].

III. RESEARCH FRAMEWORK

Development outcomes focus on system design and software quality [70]. We consider system design quality due to its presence earlier in the life of a system and due to its predictive properties for implementation success [13], [71]. It also most immediately reflects participation in the design process. System design quality is improved by decision-making activities that work toward a design incorporating diverse requirements under limited resources [70], [71]. System design features serve to clarify requirements and lend credibility to the design via diverse and functional knowledge held within the team [13]. A quality system design leads to a system that satisfactorily delivers the functionality required for business needs [70], [71].

Thus, based upon IET, the properties of coopetition, the decision-making activities, and the goal of design quality, we propose the research framework of Fig. 2. The dotted lines between the decision-making processes and quality outcomes indicate the nomological net established in IET. The cross-functional participants of the core team are the actors. Key participants from different functional units must cooperate to

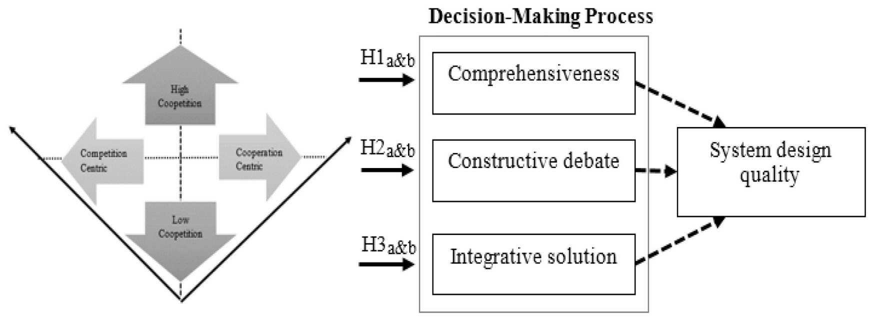

Fig. 2. Research framework.

design systems and compete for resource allocation or relative advantage.

We argue that complex interactions among the actors emerge during an LIS replacement project that defy strictly positive influences since the scope of LIS is typically replete with disparate subsystems and functionalities. Organizational goals may not fully coincide with all functional goals, and the functional goals of all key participants may not necessarily correspond with each other [33], [37]. Any change or update to the LIS could result in multiple conflicts across impacted units requiring comprehensive evaluation of potential risk, incompatible data structures and formats, and uncooperative business processes [20]. Interactions among functional units likely involve cooperation and competition simultaneously [33], [64]. That is, coopetition can balance high or low levels of competition and cooperation or sway unbalanced to being cooperation-centric or competition-centric [40].

Of the decision-making processes, comprehensiveness enhances decision quality by ensuring that each decision-maker focuses on the crucial issues of a decision, ideas are thoroughly verified, and errors in alternatives are detected before executing a particular decision [72]. Second, technical limitations of the LIS involve a complex interrelationship of systems, contradictory interests among impacted units, and normative pressures from organizational expectations [20]. Team members must openly debate which functionalities to preserve and which to add [9]. Holding constructive debates ensures that all parties communicate their concerns and underlying assumptions. Third, the LIS replacement aims to build an overall system to integrate independent and heterogeneous systems, business processes, existing applications, and data sources. Without integration, the replacement is compromised [20].

A. *Hypotheses*

Comprehensive decisions require an element of competition to consider original solution alternatives adequately [73]. Competition enhances access to knowledge stores, encourages multiple solutions, and promotes a deeper examination of alternatives [74], [75]. When competition and cooperation are considered simultaneously, the occurrence of balanced coopetition is expected to enable functional units to enhance their knowledge stores, fostering comprehensiveness [34], [62]. A team that can utilize cooperative and competitive ties simultaneously will have access to diverse perspectives and have the shared knowledge pool to filter useless knowledge [30], [33]. The balanced coopetition encourages the search for multiple solutions and generates a desire to find better ways of making comprehensive decisions [39], [41]. Thus, higher levels of balanced coopetition should produce greater comprehensiveness. Hence, this study hypothesizes the following:

> *H1a: Comprehensiveness is greater when the core team is at a high level of balanced coopetition rather than at a low level of balanced coopetition.*

Competition among team members is an essential component in enhancing decision-making processes if they share the same overarching goals [76]. Productivity is realized when a moderate level of conflict accompanies strong team interaction through a sense of cooperation toward organizational goals [28]. Yet, achieving multiple interests is a challenge without cooperation because group heterogeneity accentuates preexisting biases and stereotypes regarding the solution of a problem [22], [77]. Pulling together the diverse team into the decision-making process requires cooperative efforts if the common goal is to be achieved [78], [79].

Comprehensiveness is about systematically gathering and analyzing quantities of diverse information to achieve a complete understanding of the problem. A cooperation-centric relationship enables team members to share what they know with less informed team members, who can then use this information to assess their work processes in a way that allows them to perform higher quality work [80]. A free flow of knowledge generates more information and ideas for consideration and evaluation in the design process [81]. Cooperative cross-functional teams for new product development that share knowledge about customers and competitors generate more new products in low-intensity but not high-intensity competitive environments [55]. Thus, competition is helpful to the complete exchange of information in cooperative arrangements, but in limited doses. Hence, this study hypothesizes the following:

> *H1b: Comprehensiveness is greater when the core team tends to be cooperation-centric rather than competition-centric.*

When conflicting parties perceive common benefits in an outcome, they are likely to engage in constructive debate, learn and incorporate other perspectives, and exchange arguments and information [6], [64], [82]. Knowledge from competitive ties in cross-functional teams allows testing of different assumptions and prevents groupthink behaviors [75], [83]. Although the knowledge searching benefits of competitive ties hold in a cross-functional setting, the obtained knowledge usually suffers from severe transfer problems unless the appropriate level of cooperative ties between source and recipient has been developed [42]. Cooperation fosters a shared knowledge repository that allows diverse participants to coordinate and transfer each member's knowledge and external knowledge [38]. This added knowledge enables them to have a higher level of debate because they have more knowledge and understand how to use that knowledge to form their different points of view [47]. When considered simultaneously, high levels of balanced coopetition should enable the core team to constructively debate and express disagreements without misunderstandings [33], [63]. Thus

H2a: Constructive debate is greater when the core team is at a high level of balanced coopetition rather than at a low level of balanced coopetition.

Constructive debate requires team members to continue interacting in the face of barriers and openly discuss opposing perspectives [46]. Through debate, they learn and incorporate other perspectives and exchange various arguments [82]. Debate can occur within cooperation-centric coopetitive structures when participants believe their goals are positively related [84]. For example, constructive controversy and communication can be encouraged in a cooperative structure designed to reach a reasoned agreement [50], [85]. Greater interdependence of goals and the ensuing cooperation heighten the degree of debate because it reflects mutual self-interest and motivates participants to voice their opinions and ideas to others [86]. This greater interdependence of goals is more likely to occur within rather than across organizations. Hence, it is likely that cooperation-centric coopetition is especially appropriate for intraorganizational contexts such as system development and new product development projects.

However, some competition has potential benefits. A high level of debate is traced to ties associated with competition [87]. Still, the higher level of cooperation in cooperation-centric coopetition allows the participants to mitigate and offset threatening competition. Through cooperative efforts to improve shared interests, we can expect that competing participants can, to some extent, incorporate conflicting opinions into the group discussion. In contrast, competition-centric coopetition provides participants with little motivation to initiate actions to improve the outcomes for common interest [41]. The participants' lack of cooperative efforts makes them reluctant to voice their thoughts. The ensuing tension limits the benefits realized from diverging perspectives, and thus differences in opinions may not be discussed and, if detected, may be avoided [41]. In other words, the attainment of desired decision processes is highest when the competition is tempered with even higher cooperation. Formally

H2b: Constructive debate is greater when the core team tends to be cooperation-centric rather than competition-centric.

An essential way of dealing with tensions is to balance high competition with high cooperation [41]. Park *et al.* argue [41], p. 213, "*Balance helps maintain and control the relationship and at the same time increases the chances of realizing gains provided by both competition and collaboration*." They find that high balanced coopetition yields the most integrative decisions. Cooperation provides a shared understanding of team members' priorities, approaches, and goals [61], [62]. Even when team members have a shared understanding of the team's overall goals and deliverables, they often display self-interests and like to pursue desired outcomes [32]. The formulation of an integrative solution allows the team to see solutions from different angles and consider the competing needs of each participant; it provides a context where differences in interests and judgments are needed for arriving at a mutually acceptable agreement and incentivizing the team to cover any contingency in decision-making [3]. High levels of balanced coopetition encourage the team to be more flexible in finding a better agreement that incorporates cooperative and competitive interests [33], [63].

In contrast, low levels of balanced coopetition aim to maintain the status quo [39], passively adapting to the changes such as those caused by an LIS replacement. Because of the lack of effort, the core team with low levels of balanced coopetition is less likely to develop agreements with high integrative potential than the core team with high levels of balanced coopetition. Based on the above arguments, this study proposes the following:

H3a: There are more integrative solutions when the core team is at a high level of balanced coopetition rather than at a low level of balanced coopetition.

Teams must harness competition for advantage, requiring cooperation. Evidence in the literature is sparse but shows that competition ties are essential [88]. The weak ties associated with competition in cross-functional teams validate the solutions [83]. Structures of role, enforcement of resolution procedures, and avoidance of personal obstructions enable the benefits of functional competition. In interteam relations, competition provides access to greater cross-domain knowledge [89]. However, an LIS replacement project is embedded in an organization that imposes interdependent tasks and goals to participants to ensure the collective outcome [28], and interdependent tasks of a team cooperating on a joint problem lead to integrative solutions. De Dreu and Carnevale [90] note that the cooperative exchange of accurate information is the way to achieve high-quality decisions that integrate different parties' preferences and priorities. It is expected that teams consisting of highly cooperative members are likely to move from diversity to agreement on underlying issues [91]. Without a cooperation structure, convergence cannot result in a competitive context [73]. Cooperative negotiators reach agreements of higher joint gain [92]. Hence, they promote common interests and develop an integrative solution [50]. Formally

H3b: There are more integrative solutions when the core team tends to be cooperation-centric rather than competition-centric.

For control purposes, we considered the project management triangle elements as a perspective to systematize potential alternative explanations [93]. We conservatively believe that the appropriate use of one representative variable from each perspective can serve as a proxy to account for alternative explanations. In particular, the control variables in our study are project duration, project monitoring, and project size. Project duration represents time, measured as the number of months to complete the project. Longer projects tend to be less successful because of complexities and numerous changes [6]. Project monitoring represents cost control, measured as the extent to which the project places significant weight on completion within available resources, a tool for moving the project toward the desired output within budget [94]. Project size represents the work to accomplish, measured as the number of functional departments involved to produce the system. Research shows that larger projects tend to have more influences in the course of completion [14].

IV. Research Methodology

A. Measures

To assess cooperation and competition, we directly measure team members' specific social interdependence rather than using secondary sources like project documents or written records. Secondary sources are unlikely to capture perceptions of cooperation and competition embodied in workflows. Hence, a survey technique is appropriate for investigating the relationships between cooperation and competition that guide decision-making.

Research constructs were refined from the literature on coopetition and decision-making. Construct operationalization relied on previously used scales modified only for context and verified in a series of procedures to ensure content and construct validity [95]. The preliminary items were translated into Chinese with a conventional back-translation process and confirmed by a second researcher fluent in English and Chinese. Eight IT managers then rated applicability, clarity, and essential behavior descriptions. The content validity ratio (CVR) from experts' ratings of essential items and applicability and the content validity index (CVI) focus on item clarity. CVR and CVI of all items are higher than the cut-off value of 0.8, supporting content validity [96]. Subsequently, 32 firms joined a pilot test. Participants completed questionnaires at the company site and, as requested, noted any difficulties on the questionnaire. Their feedback ensured the relevance and understandability of the items. Sources of items and final items are in the Appendix. Each research construct was reflectively measured using the seven-point Likert scales.

B. Sampling and Data Collection

The target population for this study is medium to large companies, in which cross-functionality and functional diversity are more likely [97]. A simple random sampling method ensures that our target sample ($N = 500$) represents the wide range of LIS replacement at medium and large companies. In line with our objectives, the core team should involve all levels and functions of the impacted units and all design decisions made collectively by the impacted units through communications and consultation during the system design [13]. Our focus is on concrete participation in design decisions. Consequently, only high-level managers are included as informants in this study to ensure the credibility of responses.

Data were collected using a matching survey of senior IT managers and functional leaders in 500 sample companies. The IT managers and functional leaders of the core team participated only if directly involved in making system design decisions. This "key informants" approach provides information on the unit of analysis by reflecting on cross-functional properties [98]. The questionnaire was delivered to the IT managers in each target company, requesting that the recipients complete the questionnaire regarding system design quality. The remaining questionnaire was answered by the senior functional leader, who previously co-worked with the IT managers on the same project. An introductory letter and a return envelope were attached to the survey, and reminder telephone calls were made to the sample. Informants were instructed to consider the most recent LIS replacement projects with which they were involved rather than directly responding to our questionnaire based on past successes or failures. Using completed projects can reduce the probability of confounding events; informants are less likely to be influenced by the ongoing activities [98].

The rating of system design quality was at the beginning of the questionnaire. This placement reduces social desirability bias by minimizing the possibility of leading the informants to the desired responses on later items [99]. Assurance of confidentiality minimizes the concerns caused by mutual project evaluation within a cross-functional relationship and safeguards data reliability. Each project involving only one functional unit or having a duration of fewer than three months was removed. Consequently, the sample includes 161 usable matched questionnaires with 322 respondents directly involved in making design decisions.

Due to the nature of the data collection, we tested for potential bias before hypothesis testing. To consider potential nonresponse bias, this study compared late respondents as surrogates for a sample of nonrespondents ($n = 58$) to early respondents ($n = 103$) on all measures. We conducted a t-test and found no significant differences between the respondents and the nonrespondents. Results of the nonresponse test indicate that our samples are representative of respondents and nonrespondents. This study uses responses from two types of respondents (senior IT managers and functional leaders) to reduce the threat of common method bias (CMB). We further consider an unmeasured method construct [100] and Harmon's one-factor test to assess CMB [101]. A model that includes a single unmeasured latent method variable and all measurement items show an inferior model fit than the six-factor CFA model. In addition, more than one extracted factor is needed to explain the overall variance in measurement items. Results indicate no serious systematic method bias in the survey data. In the survey administration, all respondents were asked their level of agreement with the statement "It is very important to each employee in our company regarding how others perceive his or her behavior" to represent a social desirability score. The correlations among all research constructs and the social desirability score were all insignificant, alleviating concerns about social desirability bias.

TABLE II
DISCRIMINANT VALIDITY (CORRELATIONS AND AVE)

	1	2	3	4	5	6	7	8	9
1. Cooperation	**0.83**								
2. Competition	0.25**	**0.78**							
3. Constructive debate	0.51**	0.32**	**0.90**						
4. Comprehensiveness	0.55**	0.34**	0.57**	**0.93**					
5. Integrative solution	0.47**	0.29**	0.52**	0.66**	**0.88**				
6. System design quality	0.56**	0.23**	0.49**	0.61**	0.59	**0.89**			
7. Project size	0.01	–0.10	–0.02	–0.05	–0.03	0.03	**N/A**		
8. Project duration	–0.03	–0.08	0.01	0.01	0.07	0.00	0.24**	**N/A**	
9. Project monitoring	0.09	0.05	0.08	0.08	0.04	0.15	–0.04	0.05	**N/A**

Boldface numbers are the square root of the AVE, ** $p < 0.05$.

TABLE III
PREDICTIVE NOMOLOGICAL VALIDITY USING PLS

Results of PLS analysis	Comprehensiveness	Constructive debate	Integrative solution	System design quality
Cooperation	0.49**	0.46**	0.43**	
Competition	0.22**	0.20**	0.18**	
Comprehensiveness				0.33**
Constructive debate				0.14*
Integrative solution				0.29**
Project size				0.07
Project duration				–0.05
Project monitoring				0.11
R^2	0.34	0.30	0.25	0.47

*$p< 0.1$; **$p < 0.05$

V. DATA ANALYSIS AND RESULTS

This study employs partial least squares (PLS) path modeling to examine convergent validity, discriminant validity, and construct-level reliability in the measurement model. The choice of PLS over covariance-based SEM (CBSEM) is justified by the primary research objective and model characteristics [102]. PLS explains the residual variance of the latent variables in any regression run in the structural model, while CBSEM aims at reproducing the sample covariance matrix that creates parameter estimates close to population parameters [102]. Since this is the first study to examine the relationship between coopetition and decision-making in the context of LIS replacement, PLS is an appropriate analysis technique to maximize explained variance [102], [103].

To demonstrate convergent validity, each item is considered acceptable if its standardized loading within its respective constructs is above 0.7 [104] and the average variance extracted (AVE) is higher than 0.5, meaning that at least half of the variance in each item is accounted for by its respective construct. All items significantly ($p < 0.05$) loaded above 0.7 on their respective constructs, and all AVEs are higher than 0.5. Composite reliability and Cronbach's alpha should be greater than the recommended level of 0.7 for each construct to ensure internal consistency in construct-level reliability [104]. All composite reliability and Cronbach's alpha values exceeded 0.85. Comparing the square root of AVE with the correlation between the given construct and other constructs tests for discriminant validity [104]. The square root of the AVE for each construct is greater than any correlation between constructs. The results in the Appendix and Table II suggest that the measurement items have sufficient convergent and discriminant validity.

The predictive nomological validity of decision-making processes rooted in IET uses a set of three techniques (comprehensiveness, constructive debate, and integrative solution) linked to system design quality. This validity is tested through PLS path modeling with 1000 bootstrap samples to obtain parameter estimates and confidence intervals. The results in Table III show the significant effects of comprehensiveness, constructive debate, and integrative solution on system design quality. The observed power of system design quality exceeds the recommended level (statistical power > 0.8), implying Type II error rates are low, and the sample size is sufficient for the research model. Regarding the fit index in PLS path modeling, Tenenhaus *et al.* [105] suggest goodness of fit (GoF) for PLS and define it as the geometric mean of the average communality and average R^2 for dependent variables. Based on the effect size for R^2, Wetzels *et al.* [106] define the baseline values of GoF criteria for small, medium, and large effect sizes of R^2. The GoF of the model is 0.51, which exceeds the cut-off value of 0.36 for large effect sizes of R^2, indicating that the survey data fits the research model well.

Testing coopetition by using the product term in moderated regression analysis (MRA) is problematic. First, if the product term differs significantly from zero, researchers assert that coopetition has a positive or negative effect on the dependent variables. This finding may not truly reflect the joint occurrence of cooperation and competition because the interpretation of the product term depends on the joint distribution. Furthermore, MRA assumes the product term between the predictor and the moderator is the primary determinant of the dependent variables. Coopetition researchers invoke this assumption in testing coopetition to specify how the impact of a given predictor (e.g.,

TABLE IV
PARAMETER ESTIMATES OF THE POLYNOMIAL MODELS

Part a: Results of polynomial regression analysis						
	Comprehensiveness		Constructive debate		Integrative solution	
Cooperation (Coop)	0.49**	0.52**	0.46**	0.44**	0.43**	0.48**
Competition (Comp)	0.22**	0.21**	0.20**	0.26**	0.18**	0.20**
Cooperation^2		0.16**		0.16**		0.20**
Coop*Comp		−0.13*		−0.26**		−0.08
Competition^2		−0.10		0.07		−0.01
R^2	0.34	0.38	0.30	0.36	0.25	0.29
F-Model	41.45**	19.35**	33.69**	17.53**	26.82**	12.33**
$\triangle R^2$	0.04**		0.06**		0.03*	
Part b: Results of response surface analysis						
	Comprehensiveness		Constructive debate		Integrative solution	
Stationary point (X_0 Y_0)	(−1.14, 2.34)		(3.55, 5.56)		(0.36, 8.85)	
Balanced axis						
Slope	0.73**		0.70**		0.68**	
Curvature	−0.06		−0.06		0.07	
Unbalanced axis						
Slope	0.31**		0.19*		0.28**	
Curvature	0.16		0.40**		0.20	

Polynomial regression $Z = b0 + b1X + b2Y + b3X^2 + b4XY + b5Y^2$; Z = Dependent Variables, X =Cooperation, Y=Competition,
*$p < 0.1$; **$p < 0.05$.

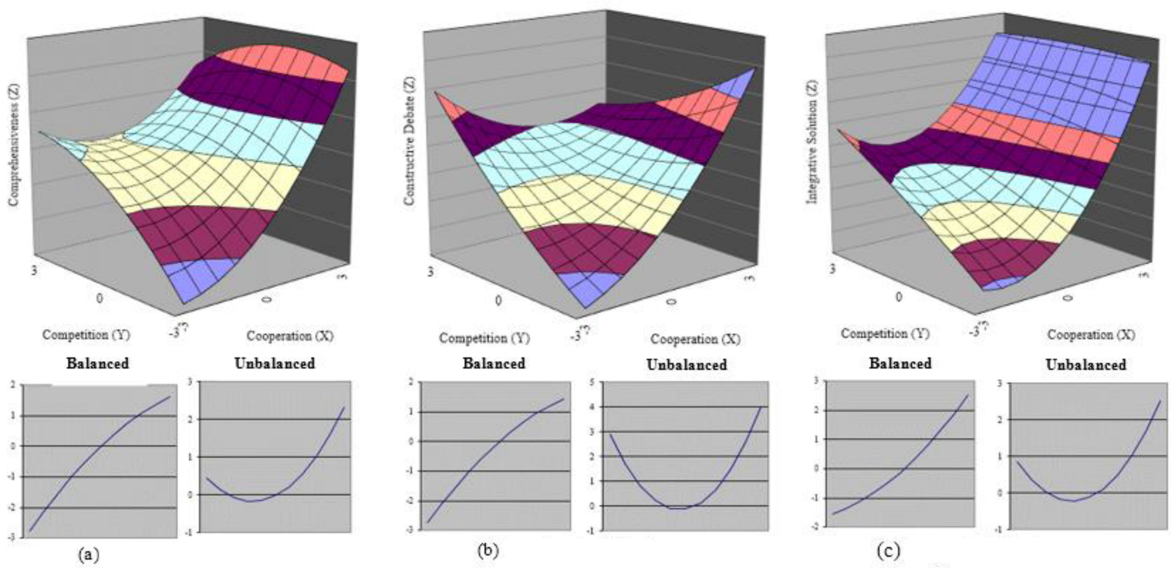

Fig. 3. Relationships among competition, cooperation, and decision making. (a) Comprehensiveness. (b) Constructive Debate. (c) Integrative Solution.

competition) varies across the different degrees of the moderator (e.g., cooperation) [32]. This variation may mask the interplay between cooperation and competition since a given predictor has been employed in the MRA before seeking the best pattern.

Lastly, using a product term in MRA can override quadratic and single effects that define dominant relationships, require congruence, or inverse relations. If the true relationship between the independent and dependent variables is not linear, MRA oversimplifies [107], [108]. Therefore, we use polynomial regression analysis (PRA) with the PLS latent variable scores to examine the shape of the relationships. Table IV (part a) shows the PRA results. Multicollinearity is assessed with the variance inflation factor (VIF). No VIF score exceeds 1.35, suggesting multicollinearity is not a serious concern. Furthermore, the residuals of the endogenous variable are tested for autocorrelation with the Durbin–Watson statistic, which is distributed from 1.8 to 2 for the dependent variables, indicating that the residuals are not correlated among themselves.

Following Edwards and Parry [108], we use the coefficients obtained from the PRA to estimate the axes' stationary points, principal axes, and slopes in the response surface analysis. We adopt a bootstrapping procedure (10 000 samples) with the bias-corrected percentile method to estimate significance levels for slopes along various axes. The stationary points and slopes of the balanced and unbalanced axes in the response surface analysis are in Table IV (part b).

Fig. 3 illustrates the three-dimensional examination of the relationships among cooperation, competition, and the decision-making process. The general patterns are approximately convex. We, next, examine the slopes of the second principal axes of the surface. We test whether the slope of the second principal axis (p_{21}) differs from 1 and whether the second principal axis shifts laterally along the unbalanced axis ($Y = -X$), as indicated by the quantity $-p_{20}/(1+p_{21})$. The bootstrapped 95% confidence intervals of p_{21} in comprehensiveness, constructive debate, integrative solution are included with 1, indicating no counterclockwise rotation off the balanced axis ($Y = X$). Furthermore, the quantity $-p_{20}/(1+p_{21})$ is not significant, indicating the lateral shift of the surface along the unbalanced axis is negligible.

We further examine the linear slope of the surface along the balanced axis and the linear slope of the surface along the unbalanced axis. The values of linear slope (a_x) along the balanced axis ($Y = X$) for comprehensiveness, constructive debate, and integrative solutions are statistically positive (0.73, 0.70, and 0.68). The results indicate that the higher score of each technique of the decision-making process increases absolute levels of both cooperation and competition. When both cooperation and competition are similarly low, the score of each technique of the decision-making process is lowest. The results indicate that the high balanced coopetition significantly influences comprehensiveness, constructive debate, and integrative solutions, thus supporting H1a, H2a, and H3a.

The values of linear slope (a_x) along the unbalanced axis ($Y = -X$) for comprehensiveness, constructive debate, and integrative solutions are statistically positive (0.31, 0.19, and 0.28), and the nonlinear slope along the unbalanced axis for constructive debate (0.40) is significant and positive. These results illustrate that comprehensiveness, constructive debate, and integrative solutions increase as cooperation deviates from competition. More specifically, the decision-making process would be higher on the right-hand side of the plot and lower on the left-hand side of the plot. The positive slope shows that the extent of the decision-making process is greater when cooperation exceeds competition than when competition exceeds cooperation. Furthermore, the curvature coefficient indicates a significant nonlinear relationship as anticipated. In total, each technique of the decision-making process has a higher score when the cooperation score is considerably more than the competition score (i.e., the cooperation-centric coopetition scenario), thus providing support for H1b, H2b, and H3b.

Although our findings indicate that cooperation and competition positively influence the decision-making process, the possible feedback loop between the decision-making process and cooperation or competition may also be true. Cooperation or competition may be endogenous and lead to inconsistent coefficients if estimated through regression. Thus, we adopt a two-stage least-squares (2SLS) approach to test the potential endogeneity problems of cooperation and competition [109]. In 2SLS analyses, our instrumental variables are relevant and exogenous. We assess the endogeneity of cooperation and competition by using the Wu–Hausman tests [109]. The result suggests that cooperation could be endogenous in predicting integrative solutions. In other 2SLS analyses, the Wu–Hausman tests do not reveal the presence of endogeneity, and thus we cannot reject the null hypothesis that either cooperation or competition is exogenous. The coefficient estimates obtained from the 2SLS analyses do not show a considerable difference in terms of the sign, relative magnitude, and significance level to the estimates made using regression. The results offer reassurance that endogeneity is not a serious threat in our study, and we do not have biased estimates from regression.

VI. Discussion and Implications

LIS replacement projects require integrating different functional groups' knowledge and processes to support the business. Expected benefits of widespread participation include psychological buy-in and a comprehensive assessment of requirements [110]. However, little is known about the best way to reach these benefits. Until now, the dominant advice for IS participation has been to structure cooperation and limit competition within a development team [14]. Such advice, however, may ignore the reality of intraorganization competition and potential benefits from competition. This study qualifies existing wisdom with the idea that optimal results require understanding the role of coopetition. Specifically, we explore whether the adoption of competition along with cooperation enhances decision-making processes.

Coopetition potentially drives superior cross-functional team performance [36]. However, past research paints an incomplete understanding of the dynamic effect of coopetition on team performance [33], [36]. This study uses the concept of balanced and unbalanced coopetition to fully allow a mixture of cooperation and competition [40]. Balanced coopetition gives the core team a higher potential to achieve quality design by elaborating information and debating divergence. In addition, the findings demonstrate asymmetrical coopetition effects on information elaboration as predicted by IET [33], [36].

Information elaboration in LIS design decision-making serves as an explanatory mechanism of the coopetition–performance relationship. The three information elaboration techniques—comprehensiveness, constructive debate, and integrative solution—can address divergences and shepherd diverse parties to focus on convergent interests. Coopetition provides the thrust to acquire diverse knowledge and conduct a comprehensive analysis by integrating conflicting opinions [36]. It is also important to note that pursuing convergence in using only cooperation may be superficial and insufficient. Instead, it should be complemented with conflicting aspects and competing interests.

A. *Implications for Research*

First, the results contribute to the coopetition literature through the application of information elaboration theory [25], [36], [39]. Often, the literature focuses on knowledge sharing and innovation as consequences of coopetition [41], [53], [55], [61]. This study adds information elaboration in decision-making in the context of LIS replacement. According to our results, a close congruence of cooperation and competition with a leaning toward cooperation fosters greater comprehensiveness, higher constructive debate, and more integrative solutions than either cooperation or competition alone. LIS replacement projects with competition among participants who cooperate may reduce the knowledge gap and create a better design [34], [53]. Competing interests stimulate participants to explore features expressing their preferences [17]. The explorations of participation in the cross-functional context should consider competition as a potential constructive factor, not as a destructive factor, and effective even when participants are not cooperating as desired in decision-making. Thus, we theoretically inform behavior in LIS replacements and extend the dimensionality of IET.

Second, our findings suggest that when cooperation is high, introducing competition will improve the decision-making process (i.e., cooperation-centric coopetition) intraorganizationally. Insightful arguments about the combination of quantitatively determining levels of cooperation and competition on organizational performance are limited [36], [41], [64]. These few studies suggest that dealing with tensions ensuing from experiencing cooperation and competition balances high competition with high collaboration. "*Balance helps maintain and control the relationship and, at the same time, increases the chances of realizing gains provided by both competition and collaboration*" [41], p. 213. However, analyses in these studies fail to consider the combined effects. PRA reveals that a heightened cooperative structure constrains one party from fostering intense competitive battles because it seeks to promote collective interest rather than narrow self-interest. A cooperative structure provides an open forum for competing participants with opportunities to understand better the other parties [15], [42], [60], [71]. In this respect, participants ensure that the collective goal is not suppressed, and participants are less likely to search for opportunities to maximize personal advantage. Under mild competition, participants who cooperate may actively perceive that the actions of other parties promote the achievement of a collective outcome while engaging in open-minded debate [50], [71], [84].

Third, the team-building literature provides insights about participants with different perspectives and their influence on outcomes [26], [37]. We explain and provide direction to this insight and show that competition and essential cooperation benefit the design. Competing interests stimulate participants to explore features expressing their desires and preferences [16], [17]. Competing parties attempt to push alternatives that increase their advantage or resist alternatives that advance their opponent's position [74]. In this regard, interactions among cross-functional participants may introduce competition into cooperative situations [33]. By this, participants create alternatives to integrate resources, requirements, and preferences to form a better outcome [33], [37]. We show that the dynamics of such interactions are critical to decision-making activities and consequent system design decisions. The introduction of competition contributes to understanding the decision-making process in a system project, and cooperation on its own is not the better approach [13].

Ignoring input on requirements, opinions, and goals in an LIS replacement system design could negatively impact system development success [110]. Our results suggest that if diverse stakeholders within the organization cannot retain their unique identity and join in making decisions, the opportunity to explore comprehensive ways to solve problems may not be realized. Recent LIS replacement failures are due to too much compromise, thus incorrectly fitting the replacement system to the organization [5], [8]. Organizations typically adopt a practice of compromise between impacted units, even though this approach usually fails to meet functionality [5], [8]. This infusion of competition limits the negative consequence of overemphasizing cooperation among the units when facing technological and organizational changes [59], [62]. As a result, units in cross-functional LIS replacement teams must cooperate and not limit the solution space when searching for consensus—competition can contradict the judgmental implications of common agreement and help highlight different facets of design [21].

Finally, we deploy a methodological tool, polynomial regression analysis (PRA), to understand better the interplay of the two coopetition continua. Previous analyses, while insightful, represented coopetition over a single continuum with cooperation on one end and competition on the other. PRA better represents coopetition conceptually because it allows us to explore the interplay of the two continua with fewer possibilities of spurious results.

B. Implications for Practice

Practitioners spend significant effort on functional involvement and participation to enhance system development performance from various cooperative perspectives [110]. However, the findings in this study support allowing competition to prevent negative consequences of cooperation and increase the likelihood of leveraging diversity in decision making. Competition is essential for increasing debate, comprehensiveness, and producing integrative solutions. Furthermore, we address the coopetition paradox and inform project managers of LIS replacement projects to maintain the long tradition of cooperation among impacted units based on common interests. Yet, when the competition among any group emerges, the manager should capitalize by allowing the competitive pressures to push greater knowledge sharing and novel solutions. Through governance of cooperation and competition at different levels (high and low), one gains the advantages and prevents the pursuit of self-interest. Cooperation-centric approaches promote a careful examination of incongruent opinions. To secure this practice, appoint a group of heterogeneous members to assist in requirements engineering, testing, training, and development. From a team composition standpoint, assure diverse perspectives and disciplines in the core design team.

Beyond team composition, aspects of structuring cooperation take center stage [37]. The potential benefits of diversity require consideration of managing the tension and conflict among cooperative and competitive parties [68]. Our study points to three techniques in making decisions—comprehensiveness, constructive debate, and integrative solution. It suggests that decision-makers should look for novel aspects of the replacement application, be aware of alternatives, and extract competing interpretations about the issues. It is important to note that diverse perspectives and interpretations must be surfaced and handled constructively. Manage competition through encouragement and control. Applying formal decision tools that foster constructive controversy, even simple tools such as an appointed Devil's advocate can encourage competition among team members. Goals can be structured to promote cooperation and inject disagreements into situations [58]. As long as tension and conflict remain focused on how best to pursue goals, there is healthy activity in making decisions. Once ideas tend to be redundant or conflict moves into the personal realm, intervene.

This control is an administrative process where actions are triggered based on observed contribution levels by competing actors.

C. Limitations

The limits of generalizability for this study have to be recognized. The theoretical framing developed in this study, from coopetition to performance through the decision-making processes, rests upon the guidance of IET. One approach for future research is to expand the scope of testing coopetition in decision-making across diverse settings, providing a better basis for understanding how coopetition links to system design quality or another criterion via other critical activities. Although we employed multiple informants to avoid potential bias, future research can go beyond perceived measures and use objective measures of system design quality or postimplementation measures. Furthermore, our survey research design is cross sectional. Past research shows that information sharing, conflict, cooperation, and competition may vary across the stages in the life of a coopetitive relationship [81]. Future cross-functional teams should use longitudinal research designs to explore information sharing and information elaboration over a project's or system's duration. Last, the coopetition continua do not include team competence aspects for elaborating information. Examining and testing competence's role in performing information elaboration within coopetitive relationships represents a vital agenda.

VII. Conclusion

Participation in system development and replacement is a main stream of systems research, but how to best structure participation to achieve desired outcomes generally goes unaddressed. Published research is not sufficient to explain participation's basic premises or normative implications. To address this deficiency, we expand the nature of participation models to consider information-elaborative decision processes and coopetitive relationships. We conceptualize coopetition as the two continua of both cooperation and competition in systems development. We advance the decision-making process as a component that adjusts to the emergent requirements of actor interactions in the competitive environment. To address the need for measures to study the model, we conceptualize and employ constructs for elaborative decision techniques and then suggest a novel approach to considering coopetition as two separate continua analyzed with a polynomial model. Our results indicate that participation must move beyond a straightforward cooperative logic to incorporate competitive relationships in a cross-functional setting, amplifying the effects of the decision-making process on the desired outcome.

Appendix

Construct Definitions and Measurement Items

Cooperation [34]	Definition: The extent of the frequency and closeness of the social interactions among key stakeholders within the core team in the system design stage	Standard loading
Composite reliability (c.r.) = 0.92	[Coop1] Members here share communications frequently.	0.82
	[Coop2] Members frequently discuss common problems.	0.84
	[Coop3] Members share close ties with each other.	0.83
Cronbach's alpha (α) = 0.89	[Coop4] The relationship among members is mutually gratifying and highly cohesive.	0.86
	[Coop5] There is much informal interaction among members.	0.79
Competition [34]	Definition: The degree to which key stakeholders compete for limited resources within the core team in the system design stage	
c.r. = 0.88	[Comp1] Members regularly compete for the limited IS resources for their departments.	0.74
α = 0.85	[Comp2] Members regularly compete over important system features from IS resources.	0.90
	[Comp3] To get more system features for their departments, other departments often have to make sacrifices.	0.71
	[Comp4] Members try to obtain more advanced system features even at the expense of other departments.	0.73
	[Comp5] Members try to gain more important system features inside the project.	0.81
Constructive debate [47]	Definition: The extent to which key stakeholders are involved in the disagreement, challenge, and controversy during system design decision making	
	[Debate1] Members actively showed different views and opinions about the system development.	0.88
c.r. = 0.94	[Debate2] Members argued different approaches to system development.	0.90
α = 0.92	[Debate3] Members openly challenged each other's opinions.	0.92
	[Debate4] Members had debates over the decisions of the system development.	0.91
Comprehensiveness [47]	Definition: The extent to which key stakeholders utilize an extensive decision process to consider multiple alternatives and adopt multiple criteria for the evaluation of these alternatives during system design decision making	
c.r. = 0.95	[Compre1] Members developed many alternative courses of action.	0.93
α = 0.93	[Compre2] Members used multiple criteria for analysis of possible courses of action.	0.95
	[Compre3] Members engaged in an extensive and in-depth analysis of all available options.	0.93
Integrative solution [52]	Definition: The extent to which key stakeholders apply information to construct a recommendation that is mutually beneficial to the others during system design decision making	
c.r. = 0.91	[Sol1] Members found integrative solutions that benefit different departments' requirements.	0.85
α = 0.85	[Sol2] Members solved the problems in ways that helped them meet their needs.	0.89
	[Sol3] Members took good ways to integrate different resolutions for different departments.	0.89
System design quality [71]	Definition: The evaluation of the final system design quality	
	[SDQ1] The design of the system functionality is satisfactory.	0.92
	[SDQ2] The design of the system has its intended functions and services.	0.93
c.r. = 0.94	[SDQ3] The design of the system has received high praise from stakeholders.	0.89
α = 0.92	[SDQ4] The design of the system features is successfully fulfilling quality expectations.	0.83

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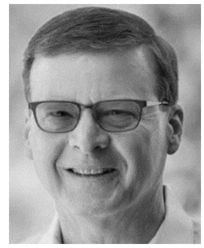

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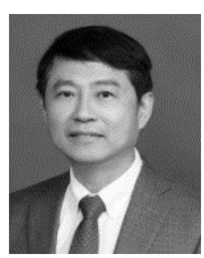

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