

Network Centric Warfare: Organizational Collaboration as a Key Enabler

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ABSTRACT

Distributed work, globalization and changing situational demands have required that military warfare tactics shift from slower conventional operations to agile, dynamic strategies. Therefore, a better understanding of more dynamic, modern-day context is needed. The present research explored the concept of collaboration in the context of Network Centric Warfare (NCW) and evaluated a metric to assess collaboration at the organizational level. Personnel (n = 240) from a logistics Command and Control organization completed a series of survey items as part of an ongoing organizational assessment. Results from a factor analysis indicated that organizational collaboration could be conceptualized according to four factors: collaboration effectiveness, collaboration adaptability, collaboration enablers, and job characteristics. The four factors were also examined to determine their relationship to other constructs, such as cohesion and trust, which are integral factors present in collaborative, dynamic environments. All four factors were positively related to organizational trust and group cohesion, thus providing concurrent validity to the organizational collaboration construct. The four factors depicted the complexity of socio-technical systems and could be used as a framework for future research on collaboration and development of collaborative systems. Implications for NCW are discussed.

KEYWORDS: methodologies, collaborative readiness, organizational collaboration, organizational performance, trust

1. INTRODUCTION

The world of work is in a period of transition characterized by globalization, distributed work, intense

competition, and dynamic contextual demands [1]. Similar challenges are being faced by contemporary military organizations as they transition from slow conventional warfare tactics to agile, more dynamic strategies [2]. This need for increased adaptability is reflected in military doctrine [3]. The Global War on Terror (GWOT) requires that the military engage with dynamic enemy forces who implement non-traditional, distributed tactics in highly unpredictable ways. Thus, the need for rapid decisions coupled with actions rooted in commander's intent are paramount to the success of future military forces and these concepts are exemplified by the construct of Network Centric Warfare (NCW). NCW involves using advanced information systems to facilitate self-synchronization and enhanced battlespace awareness among distributed forces in military operations [4]. The present research explores the concept of organizational collaboration as a key enabler to NCW and presents a novel metric to assess Net-Centric organizations from a collaboration perspective.

1.1. Performance Enablers in Net-Centric Environments

The objective of NCW is to increase decision making speed and situational awareness (SA) [5], thus making information a key commodity. Transfer of information, also known as knowledge sharing (KS), should be a key aspect of organizational performance and learning, particularly for organizations operating in net-centric environments. A seminal work discussing command and control (C2) addresses several potential challenges for future C2, and the most salient factors discussed were communication, social factors, and cognitive aspects of information work [6]. This is particularly true in Net-Centric environments characterized by the dynamic interaction of distributed knowledge workers operating through complex networks and brittle information exchanges. Command and control in the Industrial age was linear, but contemporary demands require greater

flexibility and adaptability among knowledge workers, thus creating greater collaboration requirements among coalition forces [6]. In contrast, the net-centric literature emphasizes technology solutions to the information challenges of self-synchronizing operators [5]. However, increasing the complexity and breadth of information systems creates the potential for information overload and reduced SA [7]. It is unlikely that technology alone is the answer, despite the high level of attention on building new information systems to support net-centric operations. Thus, researchers should consider other enablers of net-centric operations. One potentially fruitful area of study involves organizational collaboration.

1.2. Organizational Collaboration

Organizational networks and information relationships are becoming increasingly important in the context of complex information systems [8]. Additionally, Computer-Supported Cooperative Work (CSCW) is a copious area of intellectual inquiry among researchers and practitioners [9]. Much of the literature discussing collaboration revolves around collaborative tools, also known as groupware [9]. However, due to the proliferation of collaborative tools and the impending failure of many of these tools to reach their strategic objectives, researchers have called for increased rigor and theoretical approaches toward the study of collaborative systems [10, 11, 9, 12]. This requires researchers to re-evaluate the concept of collaboration.

Collaboration can be defined as the cooperative exchange of information resulting in a novel product or idea [13]. Collaboration transcends processes such as cooperation, coordination, and communication but is comprised of aspects of each of these processes. However, despite a multitude of attention to the topic of collaboration in the CSCW, information science, and psychological literatures, metrics for assessing collaboration and for evaluating collaborative systems are lacking. The paucity of metrics may be due to several factors including the lack of theory in collaborative tool design [10], insufficient validation data to support existing scales [14], and lack of attention toward the social and organizational variables that drive collaborative processes [9]. Given that NCW requires information exchange, collaboration is likely an essential element to Net-Centric operations.

NCW is conceptualized as an organizational phenomenon, thus collaboration at the organizational level should be most salient to improving NCW operations. The present research focused on collaboration as conceptualized at the organizational level. Organizational collaboration may encompass a variety of elements relating to an organization's ability to share and

act on information. Metrics assessing organizational collaboration must address the gamut of influences that impact the collaboration process and may involve aspects such as training, technology implementation and adaptation, organizational perceptions, and work processes. Valid metrics must also relate to constructs that exist in the same nomological network. The latter issue is problematic because of the lack of empirical research on collaboration and the paucity of collaboration metrics. Drawing from the virtual teams' literature, there has been some theoretical work in identifying potential barriers to team collaboration in computer-mediated scenarios. Ritter and colleagues have suggested that trust and cohesion among distributed military personnel, most notably distributed logistics teams, represent key aspects of the collaboration process, and these variables are important to consider when examining the collaboration process [12].

1.2.1. Trust

The need to develop, maintain, and facilitate relationships places collaboration and trust as critical enablers to organizational performance [8, 15]. Trust has both cognitive and affective underpinnings [16] but broadly represents the willingness of one person to make themselves vulnerable to actions of another person [17]. Trust is a key aspect of collaboration because it facilitates information sharing [18, 19], cooperation [16], and orients group workers toward collective rather than individual goals [20]. Trust among personnel should also be an important facilitator of performance among military personnel in Net-Centric organizations because these individuals operate at the "edge" of the technology infosphere and rely intimately on information/action from other personnel. Unfortunately, research has shown that trust is difficult to develop and maintain among distributed personnel [21]. When distributed personnel do manage to attain a high level of trust among themselves, that trust should in turn, facilitate better collaborative processes within and between Net-Centric organizations.

1.2.2. Cohesion

Similar to trust, cohesion also influences group processes and is likely related to the collaboration process. Cohesion represents the attraction of group members toward the group and the desire to be part of the group [22]. Group cohesion has been linked to enhanced overall performance [23], though there is a debate in the literature about the magnitude of this relationship. Cohesion should facilitate performance in NCW scenarios because military units that are more cohesive are likely going to be more successful in synchronizing their actions and battlespace awareness. Although, like trust, developing and maintaining cohesion in distributed environments poses a

great challenge for military forces due to their geographical dispersion. Research has shown that face-to-face teams develop more cohesion than distributed teams [24]. However, once developed, units that are highly cohesive should be better able to anticipate the information needs of their team members, thus facilitating collaboration among distributed personnel.

1.3. Purpose and Hypotheses

The purpose of the present research is to explore the construct of organizational collaboration and examine how this construct applies to NCW. We hypothesized that organizational collaboration would be a multidimensional construct to account for the complexities of the socio-technical system within which collaborative systems operate. Given the exploratory nature of this study, we made no explicit predictions about the number of dimensions that would emerge. We also hypothesized that aspects of organizational collaboration would be positively related to both trust and cohesion.

2. METHOD

2.1. Participants

Personnel (N = 240) from a large logistics Command and Control center participated in this study as part of an ongoing organizational survey. The sample consisted of personnel from various ranks within the organization. The majority of the sample was O4-O5's (31%) or GS10-14's (28%), followed by E7-E9's (11%), E5-E6's (10%), E1-E4's (8%), O1-O3's (4%), GS8-GS9 (3%), GS15-SES (2%), and O6-O10 (2%). Most personnel reported having 1-3 years of experience (37%), followed by 23% with less than one year, 16% with 3-5 years, 14% with 5-10 years, and 7% with over 10 years experience.

2.2. Materials

Items were presented in a paper-and-pencil style survey. The response scale consisted of low and high behavioral anchors (see Table 1) separated by a numeric scale of 1 to 9. Specific scales used to measure cohesion, trust and organizational collaboration are discussed below.

To measure cohesion, an individuals' attraction toward their organization units, five items were adapted from a group cohesion scale [22]. Higher scores denote greater cohesion. To assess individuals' trust within their organization, six items were modified from McAllister's [16] cognitive-based trust scale. Higher scores denote higher levels of trust.

Table 1 displays the twenty questions developed to assess individuals' beliefs about current collaborative relationships, attitudes toward collaboration in general, acceptance and availability of current collaborative tools, training for said tools, and job characteristics pertaining to collaborative behaviors. The authors developed these items based on the literature [11, 15] and observations. Higher scores denote better collaboration.

Table 1. Organizational Collaboration Items (low and high behavioral anchors).

<u>Behavioral Anchors</u>	<u>Item</u>
Low	1. I have a hard time with my job because I have to wait to get needed information
High	When I need it, the information I need for my job is readily available
Low	2. I don't get useful information from my colleagues
High	Interacting with my colleagues helps me accomplish my work
Low	3. I can't communicate with the people I need to in order to perform my job
High	When I need to, I can communicate with the people I need to
Low	4. My colleagues don't give me the information I need
High	Communicating with my colleagues helps to generate new ideas

Table 1. Continued

<u>Behavioral Anchors</u>	<u>Item</u>
Low	5. I <u>don't</u> have the tools needed to effectively communicate with my colleagues
High	My co-workers and I <u>have</u> the tools to communicate effectively together
Low	6. I could be a better performer on my job, if I didn't have to talk with so many other people to get the job done
High	I tend to communicate with others in order to get a better understanding of new situations
Low	7. People in this organization lack the skills to use our tools to communicate

High	Just about everyone in this organization is proficient in using our systems to communicate effectively
Low	9. I often receive information from others that I don't need
High	I get just the right amount of information from others to complete my tasks
Low	10. The information I receive from others is often incorrect
High	The quality of information I receive from others is very high
Low	11. The people in my organization lack the training to effectively use our systems to communicate with others
High	We have been given the appropriate training to use our communication systems effectively
Low	12. Our organization's policies often prevent us from talking with the people whom we need to talk to
High	Our organization's policies give us the flexibility to communicate with whomever we need to, in order to accomplish our work
Low	13. I do not feel comfortable in communicating up the chain of command
High	When needed, I would feel comfortable talking with my supervisor's supervisor

Table 1. Continued

<u>Behavioral</u> <u>anchors</u>	<u>Item</u>
Low	14. Efforts to introduce new technology are often unsuccessful in my organization because people can't adapt to the new tools
High	In just about every case, the people in this organization respond very well to new technology
Low	15. The types of activities that I accomplish at work rarely require input from others
High	I engage with others on a daily basis to accomplish my work activities

Low	16. I don't get useful information from people outside of my organization
High	Interacting with people outside of my organization helps me accomplish my work
Low	17. I <u>don't</u> have the tools needed to effectively communicate with people outside of my organization
High	I <u>have</u> the necessary tools to communicate with people outside of my organization
Low	18. People outside of this organization lack the skills to use their tools to communicate effectively
High	Most people outside of this organization are proficient in using their systems to communicate effectively
Low	19. The tools that I use to communicate with others outside of my organization do not work well
High	I rarely ever have a problem using technology to communicate with others outside of my organization
Low	20. If my organization introduced a new form of technology, it would take <u>months</u> before people would actually use it
High	I feel that most of the people in my organization would use a new form of technology within the first two <u>weeks</u> of being implemented

2.3. Procedure

Participants were selected from a logistics Command and Control center via stratified random sampling to participate in an ongoing organizational assessment.¹ Participants were then placed in sub-groups defined by rank structure. Thus, similar ranks were grouped together (i.e., field grade officers, company grade officers, senior non-commissioned officers, non-commissioned officers, etc.) and the groups completed several questionnaires and a group interview as part a larger study. The data was collected in a class-room setting and there was no time limit on survey completion.

¹ To ensure that privacy and security constraints were upheld, explicit details about the organization are not provided.

3. RESULTS

To assess the factor structure of the 20 exploratory items, the items were subjected to a principle axis analysis with a varimax rotation. The initial solution suggested a 4 factor solution and accounted for 65% of the variance, thus supporting the notion that organizational collaboration is a multidimensional construct, as expected. The rotated factor loadings for each of the items are presented in Table 2.

Only factor loadings of .4 or higher were considered. Item 13 (see Table 2) was the only item that didn't load onto a factor, and thus it was dropped from further analysis. In the case of cross-loading between two factors, the conceptual meaning of the item was considered and the item was classified based on its logical mapping to the overall dimension (e.g., items 5, 14, and 17). Items 1-4, 6, and 8-10 were labeled *Collaboration Effectiveness* (Factor 1) and accounted for 46% of the variance ($\alpha = .90$). Items 14 and 17-20 were labeled *Collaboration Adaptability* (Factor 2) and accounted for an additional 8% of the variance ($\alpha = .83$). Items 5, 7, and 11-12 were labeled *Collaboration Enablers* (Factor 3) and accounted for an additional 5% of the variance ($\alpha = .85$). Items 15-16 were labeled *Job Characteristics* (Factor 4) and accounted for an additional 5% of the variance ($r = .47$).

The means, standard deviations, and correlations among the variables are shown in Tables 3 and 4. All of the organizational collaboration dimensions were significantly correlated, thus suggesting the presence of a higher order construct (i.e., organizational collaboration). Additionally, all of the organizational collaboration dimensions were significantly related to both trust and cohesion, as expected.

Table 2. Rotated Factor Loadings for the Organizational Collaboration Items.

Item	Factor			
	1	2	3	4
1	.67	.38	.19	-.05
2	.79	-.03	.36	.23
3	.60	.30	.19	.12
4	.73	.07	.32	.27
5	.55	.25	.43	.17
6	.66	.16	.18	.24
7	.37	.20	.61	.12
8	.47	.32	.17	.26
9	.58	.35	.14	.25
10	.66	.28	.27	.22
11	.33	.33	.61	.08
12	.23	.31	.70	.30

13	.21	.24	.36	.15
14	.35	.50	.41	.11
15	.29	.11	.24	.50
16	.25	.25	.12	.75
17	.10	.60	.37	.40
18	.30	.59	.13	.22
19	.13	.80	.23	.09
20	.25	.52	.33	.12

Table 3. Means and Standard Deviations Among the Study Variables.

Variable	M	SD
1.Collaboration Effectiveness (.90)	6.48	1.50
2.Collaboration Adaptability (.83)	6.17	1.73
3.Collaboration Enablers (.85)	6.62	1.63
4.Job Characteristics (.47) ¹	7.38	1.52
5.Trust (.88)	6.68	1.70
6.Cohesion (.91)	5.79	1.87

Notes. Reliabilities (Cronbach's Alpha) are presented in parentheses below the variable¹ This dimension has only two items, thus the value is represented by a correlation coefficient.

Table 4. Means and Standard Deviations Among the Study Variables.

Variable	1.	2.	3.	4.	5.
1.Collaboration Effectiveness	<i>.46</i>	<i>.08</i>	<i>.05</i>	<i>.05</i>	
2.Collaboration Adaptability	<i>.62*</i>				
3.Collaboration Enablers	<i>.70*</i>	<i>.67*</i>			
4.Job Characteristics	<i>.55*</i>	<i>.49*</i>	<i>.48*</i>		
5.Trust	<i>.74*</i>	<i>.55*</i>	<i>.71*</i>	<i>.52*</i>	
6.Cohesion	<i>.63*</i>	<i>.45*</i>	<i>.54*</i>	<i>.45*</i>	<i>.71*</i>

* $p < .01$. Italicized numbers in first row indicate variance accounted for by each factor in the Organizational Collaboration Scale.

4. DISCUSSION

The present research examined the construct of organizational collaboration and its applicability to NCW in the modern-day military. The results from the exploratory factor analysis suggested that organizational collaboration is a multidimensional construct, as expected. The first dimension, collaboration effectiveness, represented individuals' attitudes about the value of sharing information, how effective they perceived their own and their colleagues' ability to share information, and an indication of the usefulness of the information they receive from their colleagues. Collaboration involves the sharing of information toward a common goal with the product of which being a novel idea, plan, or product [see 13]. This dimension assessed the value of information sharing in bi-directional information networks and while addressing individuals' attitudes toward information sharing.

The second dimension, collaboration ability, addressed the ability of the workforce to adapt to new technology and to exchange information with external sources. Researchers suggest that organizations need to consider how individuals will adapt to new technology [25], and though there are likely individual differences with this regard, technology adaptation may be captured as an organizational phenomenon. Therefore, it is useful to know the extent of the workforces' ability to adapt to new tools. This second dimension also captured the ability of the personnel to communicate with external personnel, which is also an important organizational characteristic [8]. Information exchange, both intra-organization and inter-organization, is likely a key driver of performance in Net-Centric organizations such as C2 centers [26].

The third dimension, collaboration enablers, assessed the presence of collaboration facilitators. Collaboration enablers can represent training for collaborative tools, the actual presence and usefulness of collaborative tools, or supporting organizational policies/processes. These enablers create the conditions to facilitate effective collaboration. As new collaborative systems are implemented, researchers and organizational leaders must consider the complexities of the socio-technical systems within which the technology will be implemented [9, 11, 12, 27]. In addition to effective collaboration, future military organizations that seek to implement net-centric operations must also ensure that their systems, personnel, and processes are adaptable [4, 28, 29]. Important variables to consider involve training for new tools [28], trust among employees [15], social and contextual variables [9] as well as organizational cultural factors such as an organization's propensity for collaboration [30]. Organizational cultures that are collaborative in nature are also represented by higher levels of knowledge sharing [30], suggesting this as a potentially fruitful area of inquiry. Although the full gamut of barriers to collaboration in NCW environments are likely incomprehensible, researchers need to begin to understand the constraints operating on collaborative systems and consider influences outside of the actual technology itself.

The job characteristics dimension indexed whether the activities associated with the job require collaboration. Like individuals, different jobs will likely involve disparate collaboration requirements and the collaborative tools used for specific types of work should be tailored for the idiosyncrasies associated with a particular role. Researchers suggest that activities such as problem-solving and negotiation carry a greater need for synchronous communication, whereas less complex tasks may be fulfilled with asynchronous exchanges [31]. Given the information-centric nature of C2 organizations, it was not surprising that this factor had the highest overall mean.

It was expected that aspects of organizational collaboration would be related to trust and cohesion, however the paucity of valid collaboration metrics has resulted in little empirical work with this regard. In support of these hypotheses, we found that every aspect of organizational collaboration was positively related to both trust and cohesion. These relationships are logical given the importance of communication in building trust among distributed personnel [21] and cohesion within small groups [32]. The magnitude of these relationships (r 's ranged from .45 - .71) indicates that these constructs are highly interdependent, and suggests that future research be conducted to examine

the unique variance accounted for between these variables and organizational outcomes.

4.1. Limitations and Future Research

The present results are exploratory and require cross-validation before definitive conclusions can be drawn. One apparent limitation involves the self-report nature of the data. The high inter-correlations between the dimensions suggested the presence of common method variance; however, this challenge is not unique to this study but is a risk in much survey research. Further, due to the exploratory nature of this study, little data was available to examine discriminant and convergent validity among related constructs. The paucity of valid metrics is a challenge in the burgeoning collaboration literature, thus inferring the need for exploratory studies such as this. Additionally, the present research focused on a military setting, rather than a commercial organization. Military personnel may have responded to the items differently than how employees in the commercial sector would have, particularly for items that dealt with hierarchies and chain of command issues (i.e., item 13). Future studies are needed to confirm the factor structure and to examine how the dimensions relate to other constructs such as organizational performance in non-military settings. The present research is one step toward that end because researchers first need to operationalize and assess the collaboration construct. Future research could also expound on the following questions, in Net-Centric environments, what is the level of collaborative versus autonomous work being conducted; what are the best types of work environments that would foster each type of work; what features of IT tools would be needed to facilitate the mix of collaborative and autonomous work; what is the optimal mix of technology and work design in fostering collaboration?

5. CONCLUSIONS

The present study presented a theoretical link between performance in NCW environments and organizational collaboration while examining a potential measure to assess organizational collaboration. This research extends the current literature on collaboration by exploring a metric for use in future studies and by examining how the collaboration construct relates to other variables within a similar nomological network. The concept of NCW was also discussed with collaboration being a potential enabler of NCW operations. The contemporary literature discussing NCW places technology solutions at the forefront of

the information stratosphere, thus neglecting the one absolute enabler of Net-Centric operations, the human operator. Researchers, government officials, and military personnel should acknowledge human operators and the impending collaborative processes that create the essential foundations to make NCW possible.

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