Organizational Metacognition: the Importance of Knowing the Knowledge Network

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Abstract

Knowledge networking is important to most competitive enterprises today. Enterprise knowledge is becoming ever more specialized in nature, so no single person or organization can know everything in detail. Hence addressing complex, multidisciplinary problems requires developing and accessing a network of knowledgeable people and organizations. The problem is, many otherwise knowledgeable people and organizations are not fully aware of their knowledge networks, and even more problematic, they are not aware that they are not aware. This focuses our attention toward organizational metacognition. The research described in this article involves fieldwork to investigate the metacognition phenomenon, at the organizational level, and to understand its effects in terms of knowledge networks and dynamics. Findings reveal insightful dynamic patterns and differential performance capabilities of various organizations, and highlight the importance of knowing the knowledge network. This work suggests immediate results amenable to practical application, and it suggests also an exciting agenda for continued research along the lines of this investigation.

1. Introduction

Knowledge networking is important to most competitive enterprises today (e.g., see [9, 17]). Enterprise knowledge is becoming ever more specialized in nature, so no single person or organization can know everything in detail [12]. Hence addressing complex, multidisciplinary problems requires developing and accessing a network of knowledgeable people and organizations. The problem is, many otherwise knowledgeable people and organizations are not fully aware of their knowledge networks, and even more problematic, they are not aware that they are not aware. This focuses our attention toward metacognition [8].

The research described in this article involves fieldwork to investigate the metacognition phenomenon, at the organizational level, and to understand its effects in terms of knowledge networks and dynamics. We immerse ourselves in the daily workings and conversations of an operational planning group, which draws inputs from, and coordinates actions of, myriad action-oriented groups and organizations throughout the enterprise. We look in particular for evidence of metacognition at the organizational level, and examine the corresponding performance ramifications. This research makes a contribution to the knowledge management literature by introducing and elucidating the concept *organizational metacognition,* and by highlighting the importance of knowing the knowledge network.

2. Background

By separating the term *metacognition* into its two constituent parts, we understand that *meta* signals "above" or "about," and that *cognition* signals "thinking" or "knowing." Hence metacognition implies thinking about thinking or knowing about knowing. This is comparable to concepts such as *metadata* (i.e., data about data) from the database field, *metaknowledge* (i.e., knowledge about knowledge) from the artificial intelligence field, and like uses. In the field of cognitive psychology, metacognition has been studied for some time (e.g., see [8]), but its investigation has been limited exclusively to the individual level of analysis. For instance, individual people are tested to assess their metacognitive capabilities in terms such as *feeling of knowing* (i.e., one's confidence in his or her knowledge of some topic) and *feeling of learning* (i.e., one's confidence in his or her ability to learn some new topic). This is entirely consistent with the individual-level focus of most research in cognitive psychology, through which people's knowledge and learning have been studied extensively.

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However, understanding the concepts and principles that are important for Knowledge Management, at the enterprise level, requires rising above this individual level of analysis. For instance, concepts such as *organizational cognition* [5], *organizational memory* [15, 16] and *organizational learning* [1, 6] rise above such individual-level study accordingly, and address the phenomena *memory* and *learning* at the organization level directly. This work implies that there is more to organizational memory and learning than the sums of the memories and learning of the individual people who work in an organization (cf. [14]). For instance, Nelson and Winter [9] make convincing arguments about how organizational routines and like patterns of collective action reflect knowledge beyond the sum of the individuals engaged in the routines.

Further, scholars have succeeded in building upon and leveraging individual-level concepts and principles to inform and guide organization-level conceptualization and understanding. Work on absorptive capacity [2] provides an exemplar. For instance, an individual-level principle such as, *the more that one knows about a topic, the easier it is for him or her to learn about that topic*, is applied convincingly at the organizational level, and empirical support (see [11]) in terms of firms entering competitive arenas at different times (e.g., one firm gets a head start) provides some evidence regarding the utility of this approach.

Hence organizational memory and organizational learning can be viewed as more than simple metaphors for individual-level cognitive behaviors envisioned to take place at the organizational level. Rather, organizational memory and organizational learning are viewed through this lens as organization-level phenomena directly. A substantial part of the KM literature ascribes to this view.

Through the research described in this article, we take a similar view, and apply it to metacognition directly as an organization-level phenomenon. Building upon individual-level metacognition (e.g., as with absorptive capacity noted above), we interpret organizational metacognition to mean knowing what an organization knows. With a great part of organizational knowledge—particularly experience-based tacit knowledge—resident within networks of people and organizations, this is where we look for evidence and effects of organizational metacognition in the enterprise. The primary research question underlying this study is, *how does organizational metacognition become manifest and affect enterprise performance in terms of knowledge-based work?*

3. Research design

The research design centers on immersive fieldwork to examine the phenomenon of organizational metacognition as embedded deeply within its context. Indeed, the dearth of organization-level theory regarding metacognition does not guide us adequately to even distinguish phenomenon from context in this area. Additionally, the present research is exploratory in nature, is not guided by extensive theory, and is approaching a "how" research question. Hence qualitative field research reflects an appropriate method [18].

The site selected for study involves an operational planning group, which draws inputs from, and coordinates actions of, myriad action-oriented groups and organizations throughout the enterprise. We immersed ourselves in the daily workings and conversations of this group, sought to develop grounded understanding [3], and used a combination of semi- and un-structured interviews and participant observation [13]. Following the phenomenological fieldwork of Nissen [11], we identified a military organization, and gained direct access to an international coalition of naval forces that was planning and conducting a variety of large and small, tactical missions.

Given the unique relationship that our university has with the Military, we are allowed unfettered access to the people, processes, documents and technologies associated with this planning group—as well as the action-oriented organizations with which it engages—through a period ashore in port and underway at sea.

Interview protocols were developed for two different levels of participants: one focused on executive-level participants to elicit evaluative comments about the process; the other on understanding the organization, process and environment from the perspective of the participants. We conducted seven extensive interviews with key process leaders and executives; four interviews were tape recorded and transcribed.

We also administered multiple qualitative surveys to the entire planning team, and supplemented our observations with dozens of informal conversations with them. Those survey instruments were designed to capture a description of the process, and to identify key elements of participants' knowledge inventories (i.e., to know what they know). Other sources of data included archival data regarding details of the planning process.

After assembling all of the data (e.g., field notes, interview transcripts, surveys and written organization

and process documents), a thematic coding processes was started on the interview transcripts, notes, and surveys. Categories based on related properties found in the transcripts began to emerge. As the coding process continued, and new categories were identified, all of the data were reread to see if there were any corroborating examples previously unnoticed. There were at least four complete iterations through the data.

4. Results

The focal organization in this study is called the "Combined Force Maritime Component Command" (referred to as "CFMCC," pronounced "sif-mic"), which has responsibility for the maritime, (e.g., Navy and select Marine and Merchant Marine) operations of assets from a coalition of countries. As a note, the Military relies extensively upon acronyms in most aspects of its communications, formal and informal alike. Because such acronym use reflects the culture and environment of the focal organization under study—and hence reflects the terms used directly by organizational participants—we preserve such acronyms in our discussion below. This represents an important step in terms of member checking: ensuring that organizational participants understand and relate to our interpretations from the field.

This section summarizes key results from our field research. We organize such results into three areas: 1) CFMCC Organization and Planning Process, 2) CFMCC Knowledge Network, and 3) CFMCC Organizational Metacognition. Results presented in Areas 1 and 2 are adapted from [7]. Those in Area 3 are novel, and make a unique contribution. Each set of results is presented in turn. Due to the space limitations that constrain this conference paper, and to preserve continuity for the reader, we omit the extensive quotations and like, transcribed, first-order, qualitative data from this article.

4.1. CFMCC organization and planning process

The CFMCC commander's staff had been re-organized within six months of this study. Additional modifications were continuing to be made to investigate newly developed procedures that support the targeting and scheduling work required between the planners and the personnel in Current Operations. Figure 1 depicts the basic staff structure; this is not a complete view: instead it only captures the relevant staff sections discussed in this paper. The commander was a British Navy Commodore (one star flag officer) with operations and planning experience. There was a section of special assistants comprised of both senior (e.g., Captains, Colonels, and Commanders) and junior personnel (e.g., Navy Lieutenants) from various specialties, including but not limited to Law, Special Warfare, Public Affairs and Medical. The CFMCC staff had three major staff sections employed for this study. The Operational Net Assessment (ONA) section was responsible for three areas: 1) intelligence functions including planning intelligence, surveillance and reconnaissance (ISR), 2) intelligence analysis, and 3) operations assessment. The Communications and Information Systems (CIS) section was responsible for information management (IM) and communications support. Again, these descriptions are broad, and not meant to be inclusive of all the functions. Of note, there were two primary computer networks used during this study. The secure internet protocol (SIPRnet) for U.S. personnel only, and the Coalition Naval Force network (CNFnet), which was supposed to be a mirror image of the SIPRnet; unfortunately, there was a time delay for getting data from one network to the other—that was also compounded by occasional inaccuracies in data transfer, which exacerbated the time delay as data accuracy needed to be confirmed. The paucity of CNFnet terminals was an additional hindrance to the effective flow of communications between coalition participants in different military organizations (and often in different geographical locations).

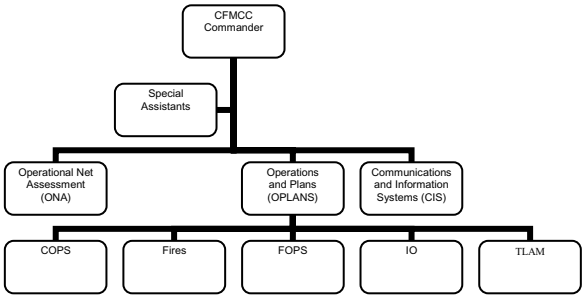

Figure 1. CFMCC organization diagram

The Operations and Plans (OPLANS) section was divided into five recognizable subsections. Current Operations (COPS) was responsible for managing current-day activities, and ensuring that orders were issued and executed. Those orders were generated based on approved plans or necessary modifications to plans based on the realities of the current situation. COPS focused on events happening within the next 24 hours. This was the first time that the OPLANS section used a distinct Fires subsection (i.e., responsible for

directing weapons fire) in conjunction with a targeting process. This subsection handled the details of prioritizing maritime capabilities (e.g., aircraft and missiles), especially those that require targeting support and coordination with the CFACC (i.e., the Air Component Command) and its asset scheduling and airspace control procedures. Fires was a static organization: each officer had a narrowly defined role in producing formatted products (e.g., Master Maritime Target List and Master Maritime Attack Plan). It was bounded to support the 24 to 96 hour time frame from the current day's activities.

The Information Operations (IO) subsection supported the CFMCC's plans development requirements by planning in parallel and in close coordination with FOPS (i.e., Future Operations). This subsection appeared to be a separate planning section due to their frequent work with highly classified information. Typically, an IO planner was physically present with FOPS when planning work was in progress.

The Tomahawk Land Attack Missile (TLAM) subsection was not an active player in this study; however, it is mentioned here because the leader of that subsection was assigned the collateral duty of being the Knowledge Management Officer (KMO) for the CFMCC staff. That officer had a daily meeting with all of the CFMCC's collateral duty KMOs to discuss information management procedures and issues. Of note, the FOPS subsection's collateral duty KM was never able to fully participate in such KMO activities due to the amount of work involved insuring that information was being posted properly to web portals and being transferred accurately from SIPRnet to CNFnet.

The Future Operations (FOPS) subsection, where the majority of the focus of this research was conducted, was comprised of a diverse group of personnel responsible for developing plans for the CFMCC commander. Led by a Marine Corps Lieutenant Colonel, the Future Operations Officer, this subsection had two Army Majors and a Lieutenant Colonel, nine Navy staff officers (two Commanders, four Lieutenant Commanders, three Lieutenants, and one Chief Petty Officer), and two Air Force Officers, a Lieutenant Colonel and a Major. Those officers brought the following functional area expertise to this subsection: Aviation (both fixed and rotary wing), Naval Special Operations, Infantry, Artillery, Military Intelligence, Surface and Submarine Warfare. There were three coalition officers—all three were surface warfare Lieutenant Commanders—the totality of the surface warfare expertise in FOPS.

In the FOPS subsection, the FOPS leader was predominately focused on interfacing with the OPLANS officer and the CFMCC commander—receiving planning guidance and delivering planning products. The development task was accomplished by assigning an Operational Planning Team (OPT) leader who assembled a team of staff officers from within FOPS based on their knowledge and expertise. The OPT leader also sought to pull in other desired expertise, mostly from within the CFMCC staff, but also from other military organizations comprising the coalition. Outside agency expertise would also have been requested if desired, and if an appropriate venue and communications capability were available. An officer assigned to FOPS might work on more that one OPT concurrently, but that did not happen during this study. As designed, the FOPS subsection supports planning beyond the current day's activities. There was one condition within FOPS that bears mentioning: trained and experienced coalition planners, although assigned to FOPS like any U.S. staff officer, became a separate sub-subsection within FOPS—they were located in a different office with other U.S. personnel that were also augmenting FOPS, but those U.S. personnel were the most junior, and had no planning training or process experience. Those details were noted by both the survey data and direct observation.

During the study, the CFMCC was required to develop branch plans to fulfill assigned missions that were received from the Commander. There were two distinct branch plans developed. The first branch plan, for a raid operation, was completed and handed over to the COPS division before planning for the second mission was assigned. The Future Operations division of the OPLANS staff section was responsible for developing those branch plans. Upon receipt of the CFMCC mission, the OPLANS officer sought planning guidance from the CFMCC commander and subsequently delivered the planning task and guidance to FOPS. Key to delivering the planning task was both the commander's and the OPLANS officer's years of experience and education in operational planning: it allowed them to impart specific focus areas and clarifying assumptions that they determined were needed for the planners to be efficient during planning process steps.

Upon receipt of the planning task, the FOPS leader gathered the "core" planners (i.e., four of the sixteen person FOPS subsection) and assigned one as the OPT leader. This group of core planners, made up of only U.S. officers, accounted for two thirds of the total relevant experience for planners—they had 30 of the 45 total years of experience. Relevant experience was determined by knowledge-inventory survey data that

indicated previous experience as an operations or plans officer for a senior (i.e., Commander/Lieutenant Colonel or above) unit commander. Furthermore, the core accounted for 40 percent of the officers that had been educated in an operational-level planning process via an official military course. After a brief meeting, each planner in this group worked independently on different portions of the mission analysis step, filled in the required output products, and brought the resulting products to a FOPS subsection meeting to review the mission analysis in preparation for briefing it to the commander. This FOPS meeting took place in a theater-like room inside the command ship. The "core" planners, who happened to account for three quarters of the highest ranking planners, were located in the front of the room and dominated the majority of the discussions that occurred during this mission analysis review. This type of plans development was repeated for the COA (i.e., course of action) development and CONOPS (i.e., concepts of operations) development steps.

From a knowledge management perspective, those steps of the process were focused predominately on *work* flows—producing mission analysis products – without incorporating much opportunity for *knowledge* flows among the subsection. This was the case in particular for coalition officers' inputs—where coalition officers could inject a non-U.S. perspective and their surface warfare expertise. It was noted by multiple U.S. and coalition personnel that the coalition planners were "under utilized," mostly "providing [solicited] advice on coalition capabilities"—information that could be found by looking in readily available unclassified publications—vice providing coalition input to the planning process.

An assessment of the planning products by a key participant revealed that they were somewhat deficient from the perspective of their knowledge content, and they required broader collaboration in order to incorporate coalition perspectives—i.e., all of the good ideas, and what-if questions that should have been present in the products. Additionally, it was recognized by U.S. officers within FOPS that there was no surface warfare planning expertise. "I really don't have a true surface warfare officer…and that is one thing that I need…." And, "The ESG was our primary input for that [surface ship planning expertise]. We had one Lieutenant, Junior Grade and one Lieutenant, but they were not always available. I'd say that we had about a 60% show time from those guys."

Interestingly, such officers were aware of *what they did not know*—at least within their own planning group—but they were unaware of *what the CFMCC organization did know*—at least by including the officers with surface-warfare knowledge from the foreign military organizations. Further, the CFMCC organization as a whole possessed such surface-warfare knowledge, but it did not know that it possessed it. These observations highlight some evidence for organizational metacognition as an observable phenomenon in the focal organization.

4.2. CFMCC knowledge network

Table 1 represents our representation of the network of knowledge sources that were *available* within the FOPS subsection to support Raid planning (i.e., the first mission of the CFMCC coalition), and it summarizes which sources were *used* for such planning. Hence it elucidates a comparison between potential and manifest knowledge sources pertaining to Raid planning.

As a note, to obviate potential problems associated with discussing classified information, we label these knowledge domains (i.e., areas of expertise) opaquely (e.g., "Op1," "Op2," etc.) in the table. The same, opaque labeling scheme applies to the participating organizations also (e.g., "Org1," "Org2," etc.). This detracts only minimally from the table's representation of the organizational knowledge network, however. Even without specific names for the organizations and knowledge domains, one can ascertain quickly the size of the network (e.g., number of rows and columns), its density (e.g., the number of non-empty cells within the table), and intensity of participation across the various organizations and knowledge domains (e.g., the number of symbols included within each cell; we discuss the specific coding of such symbols in detail below). For instance, one can see by casual observation of Table 1 that the knowledge network involves seven organizations (i.e., Org1 – Org7), addresses eight knowledge domains (i.e., Op1 – Op8), is relatively sparse (e.g., roughly two thirds of the cells are empty), and two organizations (i.e., Org3 & Org6) are involved most intensively.

Across the top are the column headings for functional expertise that was most relevant to the Raid planning mission. Each column refers to a specific knowledge domain relevant to Raid planning. For instance, knowledge in the areas of operational planning (labeled "Op1"), Raid operations (labeled "Op2"), and other domains was available for use in operational planning for the first mission. In other words, the columns represent *what* knowledge in terms of expertise was available. A letter representing a person with more than one area of functional expertise would show up in more than one column—e.g., only one Australian officer (Org 1) was assigned to FOPS,

and he had expertise in both operational planning (Op1) and surface warfare (Op4).

The row headings indicate the nationality and branch of service of the FOPS staff personnel. These headings summarize all of the major organizations and cultures that were expected to be active participants in the planning process, but exclude the CFMCC Commander's, who participated principally in the role of decision maker. For instance from the table, active participation from the Australian (labeled "Org1"), New Zealand (labeled "Org2") and US Navies (labeled "Org3"), as well as other US service planners was expected. In other words, the rows represent *who* brings knowledge in terms of expertise to support the planning process.

Cells within the table indicate the intersection of these two sets: who brings what expertise to the planning process. Further, within each cell of the table, the symbol "B" or "b" represents a participant with the rank of Commander or Lieutenant Commander (i.e., O5 or O4 grade officers) or other service equivalents, while a "C" is for a Lieutenant (i.e., O3) or below. In other words, this represents the *level* of participation in terms of rank, which serves as a proxy for multiple variables (esp. experience). Although a few Navy Captains (i.e., O6) and above participated in some aspects of the process, their participation was peripheral (e.g., supervision, decision making), hence they are excluded from the table. Moreover, *italicized* lettering represents a person that has formal classroom instruction in an operational planning process, and **bold** lettering represents a person that has experience as an operational planner. Small lettering indicates a person neither schooled nor experienced in operational planning. The column labeled "Op1" represents operational planning knowledge, and helps to draw attention to the entire FOPS subsection used for operational planning. This represents a proxy for the knowledge inventory associated with each participant.

Notice the two levels of analysis represented in this table: individual knowledge is reflected by the upper- and lower-case letters listed within each cell of the table; organizational knowledge is characterized by the rows and columns of the table. Hence one can see readily both the inventory and network levels of knowledge available for use in Raid planning, which can be viewed, together, in terms of the *potential* knowledge network (i.e., available for use).

In contrast, not all of such potential knowledge network became *manifest* during the observed Raid planning process. Specifically, only those whose knowledge was *used* to support Raid planning are highlighted with underlined letters (e.g., ***B***, ***C***). Because the table is a bit busy with the various letters and different kinds of highlighting, we indicate those cells in which at least one element of available expertise was utilized by a yellow (light) background color (shade); that is, where at least one letter in a cell is underlined, we highlight such cell for vivid contrast with those where none is underlined. Notice, for instance, that nearly every cell in the five rows representing the (joint) US Services (i.e., Org 3-7) is highlighted as such. Indeed, only one candidate cell in these five rows (i.e., labeled "Op8" for Support) is not highlighted. This reveals that the US Services were engaged actively and jointly in the Raid planning, but that key coalition partners from other military organizations were not engaged as such.

Table 1. Knowledge Network for Raid Planning

Op / Org	1	2	3	4	5	6	7	8
Org1	***B***			***B***				
Org2	*B* b			*B* b				
Org3	***B*** ***B*** c c c		***B*** ***B*** c c					c
Org4	***B***							
Org5	***B*** ***B***		***B***		***B***	***B***		
Org6	***B*** ***B*** **B**	***B*** ***B*** **B**				***B***		
Org7	***C***	***C***			***C***	***C***	***C***	

Underlined = utilized expertise
Bold = experience-based expertise
Italicized = education-based expertise
B or b = middle grade officer
C or c = junior officer or senior enlisted
Yellow/light shade = functional expertise used
Red/dark shade = functional expertise not used

This reveals also that much of the potential knowledge *available within the cells* was not utilized, even though it was immediately at hand, available, and associated directly with the knowledgeable people who were participating actively in the Raid planning process. Notice, however, the nature of such knowledge, as represented by the coded letters in the cells: all such letters are labeled as "c" (i.e., lower-case, without italic or bold highlighting). As explained

above, this corresponds to the most junior (i.e., lowest rank), least trained (i.e., with no formal training in the domain of operational planning), and least experienced (i.e., with no direct, operational planning experience) people in the organization. These people were apparently ignored largely by their more senior, better trained and more experienced colleagues. Here, the operational planning group knew of these junior colleagues' expertise, but elected apparently to ignore it. Perhaps this signals an implicit knowledge threshold for active participation in the process.

Notice further that the "Op4" cells are highlighted in red (dark) color (shade) for emphasis in the two rows representing the available and applicable Coalition partners (i.e., Org1 and Org2). This reveals that the US planners practically excluded their Coalition partners from the planning process, despite the latter bringing valuable expertise. For instance, both the Australian (Org1) and New Zealand (Org2) Navies made relatively high-level officers (e.g., O5s and O4s) available, and such officers possessed a combination of both education and experience in the planning domain. As another instance, both of these Coalition partners possessed critical expertise in the area of surface combat (Op4), *which was not directly available elsewhere in the knowledge network*. Here, in contrast to the case above pertaining to junior members of the organizations that were engaged actively, the people performing the operational planning process *did not appear to know* about this surface-combat expertise.

Notice finally how we draw a contrast between potential and manifest knowledge networks observable in the CFMCC organization. The potential network is instantiated by the rows and columns of the table, indicating which participants and what knowledge, respectively, are available for use in planning the Raid mission. The manifest network is instantiated by the cell entries within the table, indicating which specific people—and identifying their rank, training and experience as proxies for knowledge inventory—are and are not engaged actively in the Raid planning process. Our explicit representation of and contrast between these potential and manifest knowledge networks offer the potential for a diagnostic tool, through which one can assess visually at least some part of the state of organizational metacognition; that is, one can identify what the organization knows, and what knowledge it employs in a particular process. With further research, we may be able to use such diagnostic tool to identify potential performance problems likely to afflict an organization's various knowledge-based processes.

Table 2 represents the same knowledge network, and uses the same labeling and shading conventions to distinguish potential from manifest. Indeed, the rows and columns in this table are nearly identical to those in Table 1 above, and the CFMCC organization has changed little over the one week's time separating the knowledge networks depicted through development of Tables 1 and 2. Hence the *potential* knowledge network—summarizing the knowledge that is available for use—represented via Table 1 is roughly identical to its counterpart depicted in Table 2. Alternatively, the topologies of the two tables differ appreciably as they depict the *manifest* knowledge networks—summarizing the knowledge that is used.

Table 2. Knowledge network for MIO planning

Op / Org	1	2	3	4	5	6	7	8
Org 1	**B**	**B**		**B**				
Org 2	*B* b	*B* b		*B* b				
Org 3	***B*** ***B*** c c c		***B*** ***B*** c c					c
Org 4	***B***							
Org 5	***B*** ***B***		***B***		***B***	***B***		
Org 6	***B*** ***B*** **B**	**B**				***B***		
Org 7	***C***	***C***					***C***	

Underlined = utilized expertise
Bold = experience-based expertise
Italicized = education-based expertise
B or b = middle grade officer
C or c = junior officer or senior enlisted
Yellow/light shade = functional expertise used
Red/dark shade = functional expertise not used

Upon closer inspection, one can learn that the latter table pertains to the second branch planning process, which was for a Maritime Interception Operation (MIO) mission; that is, Table 1 reflects the knowledge network instantiated for the first, Raid planning mission, and Table 2 reflects the knowledge network instantiated for the second, MIO mission. Although the potential knowledge networks are nearly identical,

their manifest counterparts are not. Hence the topology of a knowledge network is contingent upon the associated mission task, and one can observe how the knowledge network changes across different missions. This makes intuitive sense, because different areas of knowledge and process participants would be expected for different kinds of missions, but diagramming the knowledge network makes such topological differences explicit, and enables the organization to know what knowledge (i.e., corresponding to its particular organizations and knowledge domains: rows and columns) is both available and in use to plan for each mission. By making such knowledge networks explicit, the organization can know what it knows, and can observe how the manifest knowledge network both compares with its potential counterpart and changes over time and across missions.

Comparing knowledge networks between the two missions, several noteworthy points become apparent. First the reader can see clearly from Table 2 that there was significantly greater diversity of inputs obtained in this latter mission planning process than in the former one. The planning meetings took place in the same theater-like room, but in the case of this MIO planning process, the products were developed collaboratively with inputs from a majority of the personnel in the FOPS subsection. This provides a stark contrast to the Raid planning described and delineated above. Notice also that no column in Table 2 is empty. This reveals how the CFMCC organization learned to improve its use of knowledge inventory over time. Hence comparing knowledge network topologies such as these can elucidate trends in organizational learning as well as highlighting different knowledge networks and inventory levels.

4.3. CFMCC organizational metacognition

From the results presented above, we find some evidence of metacognition at the organizational level. The knowledge networks summarized in Tables 1 and 2 provide one representation for such metacognition; that is, knowledge about what the CFMCC organization knows can be summarized to some extent via these tables. For instance, these tables identify which CFMCC organizations possess various kinds of knowledge that is important to its different missions.

In metacognition terms, the organization can discern what it knows by examining the rows and columns of the tables, and it can assess how its knowledge is being used by examining the cell entries within each table. Of course, one can argue that the organization knows what it knows already, and that the knowledge network tables merely make such metaknowledge explicit. Nonetheless, at the individual level, writing down what we know represents a long-standing and widely practiced approach to articulating knowledge, to sharing it with others, to making it available for analysis, and to preserving it through time. Here we illustrate an approach to doing so at the organization level, which, as noted above, is inarguably where the key emphasis of knowledge management lies.

Further, these tables reveal how the knowledge network can change over time, and how the potential knowledge network can differ from its manifest counterpart. Indeed, assessing shifts of knowledge networks across time may prove to be useful to indicate both learning and forgetting by the organization, and differences between potential and manifest knowledge networks may be useful as a diagnostic of problems with organizational metacognition. In the first case, as new participants are added to the knowledge network (e.g., expanding the number of rows in the tables), for instance, the CFMCC organization can identify additional sources of knowledge visibly, and if such participants bring new domains or areas of knowledge with them (e.g., expanding the number of columns in the tables)—or if existing participants learn in new domains or areas—then the CFMCC organization can identify new uses of knowledge visibly.

Additionally, through examination of these knowledge-network tables, we find some preliminary linkages between organizational metacognition and performance. For instance, Table 1 suggests that some knowledge possessed by the CFMCC organization was not put to use. Further analysis of the Raid mission indicates that the associated planning consumed a noticeably long period of time to complete, considerably longer than most participants would have expected. We cannot link cause and effect strongly through this qualitative study, but the connection between not accessing important knowledge and not completing the planning activities in a timely manner cannot be overlooked.

Moreover, further analysis of the MIO mission reveals that a broader cross section of knowledge possessed by the CFMCC was put to use than in the Raid mission, and that the planning processes was completed roughly three times more quickly. Again, we cannot link cause and effect strongly through this qualitative study, but the connection between accessing important knowledge and completing the planning activities more quickly cannot be overlooked.

Finally, when reviewing preliminary results of this study with CFMCC organization participants—an important aspect of member checking—we found

immediate recognition, by the participants, that the kinds of tabular, knowledge-network representations included here were informative, to the participants. For instance, several officers commented on the "missing" knowledge and participants, and accepted readily the causal links implied above between organizational metacognition (we did not use this term) and performance. Again, such findings are qualitative, and hence the corresponding evidence can be viewed as anecdotal, but this study sheds some novel, potentially impactful light on organizational metacognition, suggesting—if nothing else—that the theoretical phenomenon manifests itself in organizational practice, and that it can be observed and studied. This provides a positive contribution to the cumulative accretion of new knowledge through research, and it offers potential to open up a new avenue for KM research in to organizational metacognition.

5. Conclusion

Knowledge networking is important to most competitive enterprises today. Enterprise knowledge is becoming ever more specialized in nature, so no single person or organization can know everything in detail. Hence addressing complex, multidisciplinary problems requires developing and accessing a network of knowledgeable people and organizations. The problem is, many otherwise knowledgeable people and organizations are not fully aware of their knowledge networks, and even more problematic, they are not aware that they are not aware. This focuses our attention toward organizational metacognition.

The research described in this article involves fieldwork to investigate the metacognition phenomenon, at the organizational level, and to understand its effects in terms of knowledge networks and dynamics. Through immersive field research at sea with a coalition of military organizations, we identify multiple organizational participants and multiple knowledge domains and areas, which we are able to map visibly via knowledge-network tables. These tables reveal insightful dynamic patterns pertaining to knowledge networks—potential as well as manifest—and they suggest that some of the differential performance capabilities of the organization may be explained by the topology of the corresponding knowledge networks. This provides some evidence that the theoretical concept *organizational metacognition* can be observed and studied in practice, and it suggests that such a concept may offer useful potential in terms of diagnosis and explanation of organization-level knowing and learning.

Findings also highlight the importance of knowing the knowledge network. Where organizational participants are relatively ignorant of the knowledge network (e.g., which organizations are participating, what they know), performance suffers in terms of planning. This suggests that organizations may benefit simply through making their knowledge networks explicit (e.g., using tabular representations such as those illustrated through this work), and distributing them to the personnel involved with knowledge-based work. Indeed, explicit representation and broad sharing of enterprise knowledge have held the predominate attention of KM leaders and practitioners for more than a decade, as an uncountable number of intranet portals and sites have been developed expressly for this purpose. Using tabular representations to make knowledge networks explicit fits well within such practice. However, notice that the level of analysis differs here. Whereas most intranet portals and sites store, organize and disseminate (explicit) knowledge that an individual would seek to address his or her ignorance in some domain, knowledge network tables can be used in complementary fashion to store, organize and disseminate knowledge about where an organization might be ignorant in some domain. Further research will be required to elaborate the implications of this higher level of analysis. Here we find it sufficient simply to highlight that such implications are likely to merit further research. The field of skill management offers practical methods for developing and utilizing knowledge networks [4].

This research suggests immediate results amenable to practical application, as organizational participants are able to see immediately how knowing their knowledge networks can impact performance. We do not have much to say at this point about the best approaches to representing knowledge networks, but these exploratory results point to the potential of representing them in some form, and they illuminate a promising path for future researchers to continue work along these lines. For instance, the tabular knowledge network representation illustrated in this article can be applied to other (i.e., non-planning), knowledge-based processes of importance to military organizations, to operational planning processes conducted in non-military organizations, or perhaps extended even to the broad set of knowledge-based organizations and processes quite generally. Through such comparison and contrast, we may identify broadly generalizable potential for diagramming knowledge networks, or we may find instead that their apparent potential is constrained to our isolated study. Only through further research will we know what we know and don't know in this regard.

Finally, this research suggests also that the concept *organizational metacognition* may offer theoretical promise in terms of description pertaining to organization-level knowing and learning. Rising above the individual level of analysis, this theoretical concept may add nicely to our small but growing cache of organization-level elements that contribute toward modeling and explaining the important phenomena associated with knowledge management. Given the largely atheoretic nature of most KM research to date (cf. [11]), this may provide an important building block for advancing the science of KM research. Clearly, however, much more work needs to be accomplished in this area, as we have only just identified the potential and promise of this concept. Nonetheless, from our perspective, the potential appears to be high, and the promise is encouraging. We encourage other researchers to join us in working to understand organizational metacognition in the context of knowledge management.

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