ARL-TN-0859 ● Nov 2017

US Army Research Laboratory

Applied Knowledge Management to Mitigate Cognitive Load in Network-Enabled Mission Command

by John K Hawley and Michael W Swehla

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED (From - To)
November 2017	Technical Note	1 May 2016–20 April 2017

4. TITLE AND SUBTITLE
Applied Knowledge Management to Mitigate Cognitive Load in Network-Enabled Mission Command

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
John K Hawley and Michael W Swehla

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
US Army Research Laboratory
Human Research & Engineering Directorate (ATTN:RDRL-HRB-BB)
Aberdeen Proving Ground, MD 21005-5425

8. PERFORMING ORGANIZATION REPORT NUMBER
ARL-TN-0859

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
This report presents results from an applied knowledge management (KM) demonstration project conducted in the 2nd Brigade Combat Team of the 1st Armored Division immediately prior to and during Army Warfighting Assessment 17.1. The focus of the applied KM demonstration project was two-fold. The first objective was to assess the effectiveness of the Army KM Proponent's 3 doctrine-based KM courses: Knowledge Management Qualification Course, Knowledge Management Representative Course, and Senior Leader Executive Overview. The second objective was to assess the utility of the KM Proponent's KM Maturity Model as a tool for commanders and their senior staff to assess KM maturity within their unit, and determine concrete paths forward for KM improvements. Results pertaining to each of these objectives are presented and discussed. The KM assessment results clearly demonstrated that getting a program such as applied KM up and running in a tactical unit is a challenging undertaking. Considerable program structuring, training, developmental work, and command emphasis on the part of the target unit are required to get such a program off the ground and functioning successfully. Maintaining an effective KM program in the face of routine personnel turnover is yet another challenge.

15. SUBJECT TERMS
knowledge management, KM, information management, mission command, demonstration project, Army Warfighting Assessment, KM Maturity Model, program evaluation

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			John K Hawley
Unclassified	Unclassified	Unclassified	UU	46	19b. TELEPHONE NUMBER (Include area code) (915) 568-2896

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1. Introduction

1.2 Background

For the past 5 years (2013–2017), a team led by personnel from the US Army Research Laboratory's (ARL's) Human Research and Engineering Directorate (HRED) Field Element at Fort Bliss, Texas, has provided Human-Systems Integration (HSI) support to the Army's Brigade Modernization Command (BMC) for the Network Integration Evaluations (NIEs)[*]. The NIEs are a series of semiannual, brigade-level exercises intended to integrate and mature the Army's tactical networks in an operational context. The broad scope of the NIEs permits human performance effects and HSI issues to be assessed at the individual Soldier–system level, as well as at the system-of-systems and unit levels. In this respect, network-enabled command posts (CPs) are treated as complex sociotechnical systems of systems embedded within a multi-echelon unit context. A sociotechnical system is a work system consisting of people interacting with a technology suite intended to accomplish a specific organizational function. In the case of CPs, that organizational function is mission command.

The initial focus of ARL's HSI support was the cognitive load associated with network-enabled mission command. Simply stated, cognitive load is defined as the aggregate mental load placed on multi-echelon commanders and key battle staff personnel by an increasingly complex mission command work setting. As a construct impacting mission command, cognitive load is developed in additional detail in Hawley (2014). An additional opportunity provided by the NIEs was the ability to address the nonmateriel modifications (e.g., Doctrine, Organization, Training, Leadership and Education, and Personnel [DOTLP]) necessary to make effective use of the systems underpinning network-enabled mission command. Previous force-modernization research, along with results from the ARL team's NIE support work, suggests that robust DOTLP adaptations are on a par with materiel as contributors to enhanced mission command performance and unit effectiveness (Gonzales et al. 2005). Unfortunately, DOTLP developments and modifications often take a back seat to equipment-related concerns during the development, testing, and fielding of new materiel. Units receiving new materiel are often left "on their own" to determine how to best use that equipment to meet mission objectives. The result of this lack of emphasis on DOTLP issues early-on

[*] Following NIE 16.2, the first exercise in each NIE sequence was redesignated as an Army Warfighting Assessment (AWA). Following AWA 17.1, the BMC was redesignated as the Joint Modernization Command. AWAs were redesignated as Joint Warfighting Assessments, and NIEs were redesignated as Capability Integration Evaluations.

can be misjudgments concerning the potential military utility of new systems and technology as well as the nature of the DOTLP package required to adequately support those systems.

Based on results across NIEs, the ARL/HRED team provided specific mitigation recommendations in 3 broad areas affecting CP and mission command complexity as well as associated cognitive load: 1) mission command system design (e.g., ergonomics) and component integration, 2) knowledge management (KM), and 3) individual and team-oriented battle staff training (Hawley 2015; Hawley and Swehla 2016). Mission command component integration was further divided into interoperability effects and operational integration challenges. Operational integration refers to incorporating new materiel solutions into CP and mission command processes and procedures as well as adjusting those processes and procedures to reflect the capabilities of new technologies. New technologies often change the nature of the work processes they are intended to support (see, for example, Wickens et al. 2013). Individual Soldiers, functional teams, and units must adapt to the new capabilities they now possess.

Results across NIEs indicated that the factors previously cited combine and act to increase the aggregate level of perceived complexity and cognitive load on CP personnel. The mission command role itself is intrinsically complex and demanding. However, a work setting with a large number of design-related "rough edges" will give the impression of being more complex and intimidating than one that has been better designed and integrated. While some of the cognitive load associated with mission command in NIE CPs is intrinsic to battle staff roles, high levels of extraneous cognitive load are needless consequences of insufficient attention to HSI in component design and integration coupled with inadequate training for both individual system users and for battle staffs operating as a team. As used here, the term "inadequate training" refers to training that is 1) too short to produce necessary levels of Soldier competence, 2) ill-focused in the sense that training content does not address critical individual or team skills, or 3) inappropriate in that the instructional methods used are not suitable for the job's skill content or required level of proficiency.

"Battle staff integration" is a term used to characterize the process by which the individuals comprising a unit's battle staff learn to work together as an effective mission command team (Olmstead 1992). Inadequate individual and team-oriented training, staff member inexperience, and rapid personnel turnover within battle staffs can lead to a situation in which effective battle staff integration is not achieved, and this failure impacts mission command performance and unit effectiveness (Thompson et al. 1991; Sauer 1996).

Failure to address network-enabled CPs as systems of systems that support mission command as an integrated warfighting function was another contributing factor in perceived complexity and extraneous cognitive load. A CP is a system in and of itself (i.e., a system of systems). However, the components comprising modernizing CPs often were developed and evaluated mostly in isolation and by different proponents and vendors. Their relationship with other CP components was not always considered, and their design was not based on an understanding of complex cognitive work in context. Consequently, the pieces of the CP "puzzle" did not always fit together smoothly or comprehensively to support mission command as an integrated warfighting function. Battle staff members were often required to compensate for both component design inadequacies vis-à-vis role requirements and integration shortfalls. These deficiencies contributed to perceived system complexity and drove extraneous cognitive load. This "stove-piping" problem is not unique to mission command systems or to the Army. Many of these same deficiencies have also been noted in reports from independent sources such as the Mission Command Battle Laboratory (see, for example, MCCTS 2016).

ARL/HRED's HSI support team first identified KM deficiencies affecting mission command performance and contributing to cognitive load during NIE 14.2. The support team followed up and confirmed those initial observations during NIE 15.1. During NIE 15.2, the team was joined by a subject matter expert (SME) from the Army KM Proponent's office at the Army Mission Command Center of Excellence (MCCoE). The team once again confirmed observations regarding KM deficiencies and their effect on mission command. Potential paths forward for improving KM performance in CPs also were identified (Hawley and Swehla 2016). The test unit during all of these NIE events was the 2nd Brigade Combat Team (BCT) of the 1st Armored Division (2/1 AD).

1.2 Knowledge Management

The Army defines KM as the process of enabling knowledge flow to enhance shared understanding, learning, and decision making (HDA 2012b; HDA 2014). Applying effective KM practices ensures that knowledge products and services are relevant, accurate, timely, and usable for commanders and decision makers (HDA 2012a). Effective KM enables commanders to make informed, timely decisions despite the uncertainty of operations (ADRP 3.0 2012). An information paper on training for mission command produced by the MCCoE characterizes KM as the "Binding Idea" underlying effective CP operations (TMCWF 2013).

The cognitive demands associated with KM are not trivial, particularly in a data-intensive CP setting. Advancements in network technology have resulted in a

shift from not having all the information necessary to support operational decisions to having an overwhelming amount, where crucial information can be lost within the immense amount of data available. Results across NIEs strongly suggest this situation has led to an increased level of perceived mission command complexity and cognitive load for commanders and their battle staffs. For example, the term most often used by NIE participants to characterize cognitive load was "information overload." As one company commander put it, "We have too much information to be processed in the time allowed. It's too much for one person to handle. Sometimes, I don't know what I'm missing." High levels of cognitive load can lead to increased performance times and error rates, and a decreased likelihood of successfully accomplishing a task. Effective KM practices are thus an important contributor to moderating extraneous cognitive load and enhancing performance in tactical CPs.

Observations from NIEs indicated that inadequate KM practices in a tactical unit might not show up during routine unit operations. On the surface, a unit might appear to manage information adequately, but KM processes are neither explicitly defined, standardized, and integrated into new mission command systems, nor are they rigorously applied across unit echelons. Incidents attributable to KM deficiencies typically emerge when 1) an unexpected event forces the unit out of routine practices, 2) information-handling deficiencies impede operations, and 3) unit performance is negatively impacted. Battle staff personnel end up "chasing relevant data" to the detriment of effective mission command performance. Several such incidents attributable to inadequate KM practices were observed and documented during the NIEs. One of the best documented examples of KM deficiencies and their impact on mission command operations occurred during NIE 14.2. This example was initially cited in Hawley (2015) and is repeated here to illustrate the importance of KM to effective mission command.

The following remarks were extracted from an Observer/Controller (O/C) Drop Card from the brigade CP dated 14 May 2014, along with a supporting comment from a post-NIE command-level focus group session:

> The problem is, how does the TOC [Tactical Operations Center] manage information and create understanding? … The BDE [brigade] TOC continues to struggle analyzing and distributing information that flows into the TOC. … This is a systems management issue. There is not any cross communication of intel across the TOC floor. The BDE S-2 may collect it [intel data], but the BC [battle captain] is not populating anything on the COP [Common Operating Picture] to establish SA [Situation Awareness]. … I cannot help but think that the BDE CDR [commander] is frustrated with his intel and assisted understanding of what is occurring in the battle space. … The BDE is piecemealing the fight [each mission

> command component within the CP is operating semi autonomously with little overall coordination by the battle staff]. The network is pushing information, but the TOC is being overwhelmed with information. A lack of information management from the network is causing frustration. … Information must be better leveraged to make decisions more rapidly.

The following is an independent supporting comment from a post-NIE focus group session:

> We have the technology/capability but can't seem to figure out how to do it; we struggle to get a picture from platform to platform. How do we solve this? The network has tremendous capability but is incapable of being leveraged by BDE and below to its fullest capacity; for 4 NIEs, we have struggled to get relevant intelligence to the CO [commanding officer] and below. … We [require] components that enable staff to support the CDR intellectually.

This Drop Card is an insightful comment from an experienced O/C characterizing the roots of mission command dysfunction in the brigade CP from the perspective of complexity and cognitive load. Many issues are implied in these brief comments, but one stands out in particular: inadequate KM skills on the part of the battle staff, particularly the battle captain. Simply stated, KM is characterized as the process by which data are transformed into information (data in context), and information is then transformed into knowledge that can be used to support command decision making (i.e., to "support the CDR intellectually"). The cognitive processes that underlie KM include collecting, organizing, and summarizing incoming data to form information (data in context). Information is analyzed and synthesized to support knowledge "creation". The final step in the KM process is command decision making (Leistner 2010).

The implications of the previous comments are clear. KM was not being performed effectively in the brigade CP. Consider critical supporting remarks in turn: The network is pushing information (data); the TOC is overwhelmed with information (raw data); the brigade battle captain is not populating anything on the COP to establish SA (data are not being organized and summarized into usable information; information analysis and synthesis are not being performed); a lack of information management from the network is causing frustration. And finally a capstone remark in the Drop Card from the brigade commander: "For 4 NIEs, we have struggled to get relevant intelligence to the CO. … We [require] components that enable staff to support the CDR intellectually" (Hawley 2015).

Follow-up investigations during subsequent NIEs indicated that 2/1 AD did not have a comprehensive KM program, and key battle staff personnel lacked formal KM training (Hawley and Swehla 2016). Moreover, KM-trained personnel

assigned to the unit frequently were not used in their doctrinally defined roles. Similar observations regarding KM implementation in tactical units are not unique to 2/1 AD, but have shown up in other units during Combat Training Center (CTC) rotations and other mission command–related events (MCTPTDAWE 2014; MCCTS 2016). These results from NIEs and from other relevant exercises led directly to an applied KM demonstration project involving 2/1 AD as part of Army Warfighting Assessment (AWA) 17.1.

1.3 Purpose

This report presents results from the applied KM demonstration project conducted in 2/1 AD immediately prior to and during AWA 17.1. The focus was two-fold. The first objective was to assess the effectiveness of the Army KM Proponent's 3 doctrine-based KM courses: Knowledge Management Qualification Course (KMQC), Knowledge Management Representative Course (KMRC), and Senior Leader Executive Overview (SLEO). The second objective was to assess the utility of the KM Proponent's KM Maturity Model as a tool for commanders and their senior staffs to assess KM maturity within their unit and determine concrete paths forward for KM improvements. Specific assessment questions nested under these overall objectives included the following:

- How effective is the KMQC in preparing KM Officers (KMOs) to execute the duties and responsibilities of a KM professional?
- How effective is the KMRC in preparing staff KM Representatives (KMRs) to support the KMO in conducting unit KM operations?
- How effective is the SLEO in ensuring that senior leaders understand KM fundamentals and how it enables mission command?
- Does the KM Maturity Model enable the unit to fully assess unit KM posture?
- How does formalized training (KMQC, KMRC, and SLEO) contribute to shared understanding throughout the operations process?

Each of these KM courses and the KM Maturity Model are briefly described in the following.

Knowledge Management Qualification Course. The KMQC is a 3-week, 120-h course intended to provide officers, noncommissioned officers (NCOs), and Department of the Army (DA) civilians assigned to KM positions the education and training in the core skills necessary to successfully perform KM duties. The course is intended to prepare Soldiers to perform KM Section Officer and Soldier

responsibilities in support of mission command execution. The course emphasizes Army KM doctrine and enabling tactics, techniques, and procedures (TTPs). It is intended to prepare graduates to be effective KM leaders in a variety of organizations. Graduates should be able to lead KM coordination, planning, and execution in a range of positions.

Knowledge Management Representative Course. The KMRC is a 20-h course provided by an instructor team from the Army KM Proponent's Office. The team presents the course at a location of the target organization's choosing. The course is intended to provide designated unit personnel with the knowledge and skills necessary to serve as KMRs within their organization. The KMRC focuses on the components of KM—people, organization, processes, and tools—and their interaction to support mission command within an organization. The course focuses on pairing the subject matter expertise of Soldiers with KM best practices to enhance mission command and organizational effectiveness.

Senior Leader Executive Overview. The SLEO is a 1- to 3-h KM overview for the senior leaders of brigade and higher echelon organizations. The course focuses on the importance of leveraging KM assets within their organizations and the application of Army KM best practices to improve mission command and organizational performance. The SLEO is provided in conjunction with the KMRC.

KM Maturity Model. The KM Maturity Model is a computer-based tool (i.e., a spreadsheet) intended to assist organizations in assessing the maturity of their KM program. The tool is intended to provide a way to evaluate organizational "efforts" or KM activities to include people, processes, and tools using a simple 1-5 Likert rating scale. The efforts listed in the tool are based on doctrinal requirements or emerging KM best practices and are linked to mission command effectiveness. The KM Maturity Model is intended to guide the KMO and KM Working Group (KMWG) in their initial development of an applied KM program in a tactical unit. The KM maturity Model also is potentially useful in tracking a program's progress over time. Appendix A provides an overview of the KM Maturity Model. The material in Appendix A was provided by the Army KM Proponent.

2. The Applied KM Demonstration Project in 2/1 AD

2.1 Program Initiation

All 3 KM-related courses were conducted with 2/1AD Soldiers during the summer of 2016, immediately prior to the start of AWA 17.1. The unit appointed a KMO (2/1 AD's Network Services Technician, a Chief Warrant Officer 2 [CW2, holding Military Occupational Specialty [MOS] 255A), who attended the 3-week KMQC

presented by the KM Proponent at Fort Leavenworth, Kansas. The brigade also identified and appointed KMRs for each of 2/1 AD's subordinate tactical units. The Army KM proponent provided the KMRC and SLEO to unit staff and leaders (battle captains, operations NCOs, battle NCOs, etc.) from across 2/1 AD on-site at Fort Bliss, Texas, during the period 23–25 August 2016. Unit personnel attending the KMRC also conducted a baseline application of the KM Maturity Model.

Following the KMRC, the unit's operational tempo and other activities associated with the run-up to AWA 17.1 limited any KM-related start-up work the KMO had planned. For example, the KMO was busy full-time in the AWA 17.1 Integration Motor Pool until very near the start of the exercise. The KMO later remarked that he did not think he was the right person to fill that role, noting that he was not familiar enough with mission command staff operations to function effectively as the unit's KMO. Rather, he stated that the KMO should be a person from the operations and training (S-3) section of the brigade's staff. The KMO also commented that serving in that role is a full-time job and should not be viewed as a role that can be performed in combination with another full-time job. This is particularly relevant during the applied KM program's start-up phase.

Until recently, the KMO billet at the BCT level was a Functional Area (FA) 57 O-3 (captain). There had been an earlier grade plate review that dropped the rank for the KMO slot down from an O-4 (major). Then, the FA 57 O-3 KMO slot was eliminated from the BCT Modified Table of Organization and Equipment (MTOE). More recently, the Maneuver Center of Excellence (the "owner" of the BCT MTOE and the entity that had eliminated the O-3 KMO slot) identified this deletion as a "gap" and recommended the BCT executive officer (XO) as the KMO. Based on results from AWA 17.1, assigning BCT KMO responsibilities solely to the XO should be reconsidered. Both XO and KMO can be full-time roles. The BCT XO might be assigned overall responsibility for the unit's applied KM program, but he or she must be adequately supported in performing that role.

KM-related research indicates that viewing KM as primarily an "IT [information technology] problem" and assigning responsibility for KM primarily to IT personnel can result in "unnecessary IT spending, masses of unused data, and information overload" for consumers of that information (Vanini and Bochert 2014). IT personnel typically do not know what information is relevant for management personnel. That same literature suggests that KM is primarily a management responsibility, with essential technical support provided by the organization's IT section. These results support the finding and recommendation previously provided. The lead person for KM in a tactical unit such as 2/1 AD should be from the S-3 section. However, that lead must be supported by and work closely with technical personnel from the S-6 (signal) section.

In the interim between the KMRC and the start of AWA 17.1 (August–October 2016), the test unit's KMWG did not meet face to face. Moreover, only 2 of the unit's designated KMRs signed on to the milSuite virtual collaboration site provided by the KM Proponent. The idea of a virtual KMWG collaboration in lieu of face-to-face working group contact and collaboration did not work as planned prior to or during AWA 17.1. Attempting to initiate the unit's KM program in parallel with the run-up to an intense and demanding event such as AWA 17.1 resulted in too little time and key personnel availability to get the program off the ground successfully. As a consequence, the KM analysis team had very little empirical basis on which to address the applied KM training program's effectiveness or its effect on KM practices or mission command effectiveness during the subsequent exercise.

The unit's KMO later remarked that a milSuite virtual collaboration site might be useful if it was used in combination with periodic face-to-face working group meetings. He noted that the virtual collaboration site could serve as a forum to exchange, review, and critique KM-related products such as KM standard operating procedures (SOPs). The KMO also stated that during program initiation, frequent face-to-face working group meetings might be essential to "gel" the KMWG (i.e., create an integrated functional team) and "get the program off the ground." Given that the KMWG did not meet face to face, that team gelling process did not occur in 2/1 AD prior to or during AWA 17.1.

2.2 Assessment Results

Over the course of AWA 17.1, SMEs from the MCCoE, in collaboration with supporting ARL team personnel, conducted field observations and guided interviews with unit personnel who had completed the KMRC and SLEO. At the end of the exercise, personnel from the KM Proponent's office and ARL conducted focus group sessions with members of the KMRC and several of the test brigade's battalion commanders and their key staff members. The analysis team intended to use the post-exercise focus group sessions to collect additional information concerning KM training effectiveness and the program's perceived impact on mission command performance during the preceding AWA.

Course Effectiveness. Going into the applied KM demonstration project, the ARL team had planned to use what is termed the Kirkpatrick Model for assessing KM training effectiveness (Kirkpatrick and Kirkpatrick 2006). The Kirkpatrick Model considers the value of any type of training across 4 levels. Level 1, *Reaction*, evaluates how participants respond to the training: Did they like it? Level 2, *Learning*, measures whether trainees actually learned the material in question: Do

they think (or demonstrate in a practical exercise) that they learned the course material? Level 3, *Behavior*, considers whether the trainees are able to apply what they learned on the job: Could they use the training to set up and execute an effective applied KM program? Level 4, *Results*, evaluates whether or not the training positively impacts the organization: Does the unit do a better job managing information during mission command operations?

In the case of applied KM training in 2/1 AD, trainers from the KM Proponent's office administered a short questionnaire addressing KMRC trainees' reaction to the training following course completion. Trainee responses concerning how the course was conducted were generally positive. Most trainees also judged that they had learned the course material. During a subsequent interview session, the brigade KMO also reported that he liked the 3-week KMQC (Reaction) and asserted that he had learned the material in question (Learning). That said, considerable caution must be used when taking trainees' post-training reaction and perceptions regarding learning at face value. Prior experience with Army training similar to that offered as part of the applied KM program has indicated that personnel attending new equipment–type training will often end up "knowing about" the material in question but may not actually "know how to do" what they are now being asked to do (Hawley 2007). That is, course participants will often judge the training favorably and assert that they learned the material. However, when actually called upon to apply training-related knowledge and skills in their work setting, they fall short. At that initial stage of program familiarization and learning, they simply "don't know what they don't know". The training evaluation questionnaire administered at the conclusion of the KMRC is shown as Appendix B. The response range was from 1 (Strongly Disagree) to 5 (Strongly Agree). The midpoint value 3 was neutral: Neither Disagree nor Disagree. Means and medians of the trainee responses to each of the items on the training evaluation questionnaire are provided in Table 1.

Table 1 Means and medians of trainees responses to items on the KM training evaluation questionnaire (n = 15)

Questionnaire item	Mean	Median
I now have a better understanding of what KM provides.	4.00	4
I better understand how the people, process, and tool components of KM support the organization.	3.88	4
I better understand how knowledge flows to create shared understanding.	4.06	4
I better understand how KM supports the operations process.	4.13	4
I better understand how to apply the KM process within my staff position and role.	3.88	4
I better understand the different roles and responsibilities of people (Soldier, KMO, KMR, chief of staff, etc.) in the KM process.	3.81	4

Table 1 Means and medians of trainees responses to items on the KM training evaluation questionnaire (n = 15) (continued)

Questionnaire item	Mean	Median
I better understand vertical and horizontal collaboration.	4.25	4
I believe this training will enable better information sharing throughout my unit.	4.00	4
I better understand how to leverage tools enabling information sharing.	4.19	4
I believe I can use the knowledge gained in training to assist in creating, executing, and evaluating a KM unit plan.	4.31	4
I believe training prepared me to use the KM maturity model to conduct a unit KM assessment.	4.06	4
I believe the KM maturity model can assist me in identifying knowledge sharing weaknesses in my unit.	4.19	4
I believe my leaders will embrace KM to better our unit shared understanding and collaboration.	4.31	4

Because the applied KM program was not fully implemented in 2/1 AD prior to or during AWA 17.1, it was not possible to conduct any assessment relevant to Levels 3 and 4 of the Kirkpatrick model. Few empirical data were available concerning whether the KMO or the KMRs were able to apply what they learned during the KM training sequence on the job. Similarly, Level 4, organizational impact, could not be validly assessed.

Maturity Model Utility. Based on 2 initial applications, the KM Maturity Model showed promise as an effective way to assess the status of KM within a unit. The initial application of the Maturity Model at the conclusion of the KMRC indicated that 2/1 AD's KM Maturity Level was rated as 2.7. A second application of the Maturity Model during the post-exercise KM focus group session indicated that 2/1 AD's level of KM maturity had improved slightly but not significantly: it was still rated as between 2 and 3. KM Level 2 is defined as "Some KM processes are repeatable, possibly with consistent results. Process discipline is unlikely to be rigorous." Level 3 is characterized by defined, documented, and disciplined KM processes across the brigade and subordinate tactical units that are also subject to some degree of improvement over time.

Based on observations from multiple NIEs and the current AWA, the consensus opinion of ARL's KM assessment team was that these initial assessments of 2/1 AD's KM maturity level were likely overstated. Based on the definitions cited, actual KM maturity was likely closer to a 2 than to a 3. Unit observations and focus group results also suggested there was considerable variability in KM practices across the test brigade's subordinate battalions. For example, one battalion appeared to have made some use of the training provided in the KMRC, while other battalions demonstrated no course impact. Some of this variability across subordinate units was reasonably attributable to the fact that the brigade did not have a disciplined KM framework. A reasonable goal going forward is to raise the

brigade's overall KM maturity level to an actual 3. This would require that the applied KM program be initiated and in place long enough to demonstrate positive results. Merely starting the program is not sufficient. KM personnel (KMO and KMWG) must apply what they have learned and practice KM-related skills in increasingly challenging mission command training events. The Maturity Model could be used to track the status of a unit's KM status over time after an applied KM program has been introduced and program execution has begun.

ARL/HRED's analysis team also noted that a number of the KM Maturity Model's assessment criteria are subjective, which can lead to a misrepresentation of a unit's actual level of maturity. A common criticism of Likert-style self-evaluation questionnaires is that raters tend to overrate themselves (Babbitt and Nystrom 1989). That is, raters tend to rate themselves as being better than they actually are. A standard method for reducing subjectivity in Likert scale assessments is to provide anchor points for each of the scale values. Scale point anchoring would involve providing more detailed, situationally relevant descriptions for each scale point on each KM criterion.

A second observation concerning the validity of the KM maturity model pertains to the relative importance of the various groupings of rating scales used in the assessment. Are all of the primary KM domains used in the model equally relevant to actual KM practices within a tactical military organization? For example, overall KM maturity for 2/1 AD appeared to be overly influenced by high scale scores within the Organization/Culture domain. The scales defining the Organization/Culture domain are important with respect to how well an organization is able to execute a functional KM program. However, it is possible to have a "good" organization, as rated on those scales, that does not manage its information well. That said, the maturity rating process within a tactical organization should focus more on a unit's actual information management (IM) practices and less on supporting organizational characteristics. The importance assigned to the various maturity domains should thus be adjusted to better focus on and reflect actual IM practices as applied within a tactical military organization. Weighting the KM domains to better focus on a unit's actual IM practices is another potential way to improve the Maturity Model's validity and utility.

The Army KM Proponent's applied KM program is evolving. The KM Proponent's initial concept was that a training program consisting of the KMQC, KMRC, and SLEO along with the virtual milSuite collaboration site and occasional unit contact would be sufficient to get an effective applied KM program up and running in a target unit. Experience from organizational development initiatives similar to KM suggests, however, that training alone is not sufficient to initiate an effective intervention in a target organization (Schein 2004). As noted previously, unit

personnel attending such training will often end up knowing about the program in question, but will not actually know how to do what they are now being asked to do. Some amount of follow-on consultation and guided practice is necessary to move from knowing about to knowing how to do, to actually doing those things successfully in their job context.

In the case of the Army's KM program, the KM Proponent does not have sufficient resources to support both training and extensive follow-on consultation across all of the Army's BCTs; hence their effort to initiate a milSuite virtual collaboration site that might take the place of continuing face-to-face contact with receiving organizations. Experience with initiatives similar to KM also suggests that beyond consultation and other forms of reach-back, it is useful to provide receiving organizations with prepackaged model solutions (i.e., "school" solutions) that the receiving organization can use to quickly get their applied program started. These prepackaged solution sets can be customized to fit the target unit's circumstances. They also enable a program "quick start" (a necessary attribute to enable initial program "successes" and sustain organization interest), and explicitly demonstrate to the organization "what right looks like" in critical program areas. Follow-on consultation and guided practice in "doing" KM (also essential) are then organized around these prepackaged solutions sets. Contact with the receiving organization thus has a concrete, action-oriented focus on supporting incremental KM improvements in the target organization.

3. Conclusion: Toward an Effective Approach to Enhancing KM Proficiency in Tactical Units

As stated previously, the overall objective of the applied KM demonstration project in 2/1 AD during AWA 17.1 was two-fold. The first objective was to assess the effectiveness of the Army KM Proponent's 3 doctrine-based KM courses. The second objective was to assess the KM Maturity Model's utility as a tool for commanders to determine KM maturity within their unit and to lay out concrete paths for KM improvements. These capstone objectives were further broken down into 5 specific assessment questions. Demonstration project results as they apply to these assessment questions are summarized in the following section.

3.1 Demonstration Project Results in Relation to Subordinate Assessment Questions

Assessment Question 1: How effective is the KMQC in preparing KMOs to execute the duties and responsibilities of a KM professional?

The 2/1 AD's designated KMO attended the KMQC prior to the start of AWA 17.1. The KMO reported favorably on the course and indicated that he had learned the course material and was prepared to serve in the KMO role. That said, the assessment team was not able to obtain any empirical data pertaining to the KMQC's actual training effectiveness or later impact on the unit's mission command effectiveness. The applied KM program in 2/1 AD was not implemented as initially planned. The KMO later noted that as a CW2 Network Services Technician he was not the right person to serve as KMO. He judged that he did not have a sufficient background in battle-staff mission command operations to function effectively in the KMO role. The KMQC by itself cannot be expected to compensate for a lack of relevant staff-related training and experience.

Assessment Question 2: How effective was the KMRC in preparing KMRs to support the KMO in conducting unit KM operations?

As with the situation involving the KMO, KMRs attending the KMRC had a generally favorable view of the course and reported that they had acquired the necessary knowledge and skills. However, since the KM program in 2/1 AD did not get off the ground as initially planned, there was no evidence to support the course attendee's assertions that they learned the course material or would have been able to apply what they learned on the job. The KMWG did not meet face to face, and KMR participation with the milSuite virtual collaboration site was minimal. Hence, there was no empirical evidence that the unit's KMRs were prepared to support the KMO in structuring and conducting applied KM operations. The only positive results pertaining to this assessment question were observed in one of the brigade's subordinate battalions. That battalion commander used his trained KMRs to staff his command vehicle and support enhanced IM within his unit. Once again, however, these conclusions are observational and anecdotal.

Assessment Question 3: How effective is the SLEO in ensuring senior leaders understand KM fundamentals and how it enables mission command?

With the exception of the observation concerning the battalion commander referenced in Question 2, there was no empirical evidence bearing on this assessment question. Only 2 battalion-level commanders attended the post-exercise KM focus group session. No personnel from the brigade's command group or senior staff attended the post-event KM focus group session.

The ARL personnel on the KM assessment team observed that the test unit's command and senior staff personnel did not appear particularly interested in the applied KM demonstration project. They did not interact much with the presenters during the SLEO (remaining mostly passive), and attendance at the post-exercise KM focus group session was sparse. In fact, the post-exercise focus group session was late getting started because designated attendees did not appear. Other unit activities had been scheduled over the focus groups session in spite of the fact that the KM focus groups session was scheduled well in advance of the designated time. ARL assessment team members debated among themselves concerning the reason for this seeming lack of interest in the applied KM demonstration project. One experienced member of the ARL team opined, "They appear to think they are OK, and don't need this program." That is, the unit appeared to be complacent with respect to KM and satisfied with the status quo. This observation is similar to observations pertaining to other aspects of battle staff training and staff performance deficiencies reported in the literature (Thompson et al. 1991; Howse and Cross 1999).

Thompson et al.'s field studies of battle staff training and performance revealed systemic training problems in preparing officers to assume battalion staff duties. These authors reported that most training received by new staff officers was ad hoc on-the-job training. The ARL team's observations across NIEs indicated that this situation has not changed (Hawley 2015; Hawley and Swehla 2016). Moreover, Thompson et al.'s interviews with battalion commanders and senior staff officers further indicated that unit leaders did not think that leader and staff training exercises (e.g., Command Post Exercises) were important and did not think it was necessary to conduct these exercises frequently. These authors concluded that battalion commanders and senior staff officers "lacked the perception" necessary to assess their true condition because "they had not had sufficient training and experience to know what they must do to operate effectively" (Thompson et al., p. 32). Mission command problems began to emerge only under the stressful combat-like conditions encountered at the CTCs, where units must truly plan, prepare, and execute using mission command resources as they would under actual combat conditions. These requirements include staff actions and synchronization of command and staff functions under harsh time and resource constraints. Thompson et al. concluded that CTCs may be the only place where commanders and staff are sufficiently taxed to reveal flaws in mission command training. Such flaws are not revealed during routine home station training or less-stressful and dynamic exercises. Recent reports from the CTCs suggest this is still the case (MCNS 2017).

Recent literature sources also suggest that the emphasis on counterinsurgency (COIN) and stability operations for the past 15 years has resulted in a set of command and staff practices suitable for COIN but less suitable for traditional maneuver warfare. Moreover, commanders and senior staff may not be aware that practices that proved adequate for COIN and stability operations may not be sufficient for mission command during high-intensity maneuver operations (MCCTS 2016). With respect to knowledge and information management (KM/IM), that same report noted that the "SOPs and TTPs developed to maintain digital/analog balance while conducting unit KM and IM processes [during COIN and stability operations] may not be directly applicable to future decisive action/unified land ops [operations] needs" (MCCTS 2016, p. 16).

Assessment Question 4: Does the KM Maturity Model enable the unit to fully assess unit KM posture?

As noted previously, the KM Maturity Model shows promise as a tool for assessing a unit's KM posture. Demonstration results suggested that the model could benefit from being more objective with respect to a unit's actual KM and IM proficiency. Suggestions for making the model more objective and indicative of a unit's actual KM and IM proficiency were provided in Section 2.2 of this report. The model's utility could also be improved by providing users with concrete, action-oriented steps for improving their KM posture, such as moving from Level 2 to Level 3 or from Level 3 to Level 4.

Assessment Question 5: How does formalized training contribute to shared understanding throughout the operations cycle?

Because of the failure to implement an applied KM program in 2/1 AD prior to AWA 17.1, there were no results that pertain directly to this assessment question. This question relates to Level 4 of the Kirkpatrick model, and no results relating to the program's effect on mission command or unit performance were obtainable during AWA 17.1.

3.2 Observations and Recommendations

The KM assessment results discussed in the previous section clearly demonstrated that getting a program such as applied KM up and running in a tactical unit is a challenging undertaking. Considerable program structuring, training, developmental work, and command emphasis on the part of the target unit are required to get such a program off the ground and functioning successfully. Maintaining an effective KM program in the face of routine personnel turnover is yet another challenge. At the conclusion of the KMRC in August 2016, the structure

and initial personnel fill for an applied KM program in 2/1 AD were in place. However, there was not sufficient time or key personnel availability to turn that program structure and concept into effective program execution prior to or during AWA 17.1. Consequently, the KM assessment team had very little empirical data with which to address any of the assessment criteria addressing KM training effectiveness or the program's operational effect. In spite of these limitations, the assessment did provide several observations and recommendations concerning KM program effectiveness and potential improvements going forward. These observations and recommendations are summarized in the following paragraphs.

Observation: The KMRC primarily informs Soldiers about KM principles and concepts. Although the course output does result in initial products for the KMWG, additional hands-on, practical emphasis during training is necessary.

Recommendation: The KM Proponent should coordinate with operating and generating force KMOs to customize the KMRC to reflect the unit's KM program. Another suggestion is to include the unit's KMO as a key facilitator during the KMRC.

Observation: The KM Maturity Model shows promise as an effective way to assess the status of KM within a tactical unit.

Recommendation: The MCCoE and KM Proponent should investigate the use of the Maturity Model to track the status of a unit's KM over time after an applied KM program has been introduced and program execution has begun. Data from such repeated applications could also serve to refine the model and better define in operational terms what is meant by a unit's KM "maturity".

Observation: The KMRC and the SLEO were catalysts in one of the brigade's battalion-level units to mature and enhance its KM program. The unit commander appeared to have a high appreciation for information flow and KM; therefore, he placed Soldiers in key positions (battle captain, battle NCO, and commander's driver) to attend the KMRC. These Soldiers, armed with a new understanding of KM, were allowed to implement improvements to the unit's KM program, information flow, and information display at the battalion level.

Recommendation: This observation is an example of a KM best practice. It also illustrates the potential benefits of enhanced KM practices in a tactical unit. Examples such as this should be used to refine the SLEO "sales pitch" and provide practical "how to" advice to units initiating an applied KM program.

Observation: The BCT's KMO was not familiar with staff operations and was too busy as a Network Services Technician to initiate the applied KM program in conjunction with the KMWG. The 2/1 AD KMO (a CW2 Network Services

Technician holding MOS 255A) was not the right person to fill that role at the brigade level. A person from the unit's S-3 section with a background in the Military Decision Making Process and battle staff operations would have been a more suitable choice.

Recommendation: The KMO at the brigade level should be key member of the S-3 staff section. Moreover, the MCCoE should investigate assigning battle captains or NCOs as KMRs in subordinate units. The MCCoE also should explore the need for a mission command integration specialist (e.g., a Mission Command Digital Master Gunner) to be assigned to the commander's vehicle to support enhanced IM.

Observation: KMWG virtual collaboration using the KM proponent's milSuite site did not work out as intended.

Recommendation: A milSuite virtual collaboration site might be useful in combination with periodic face-to-face KMWG meetings. Face-to-face collaboration by the KMWG is essential during applied KM program start-up.

Observation: As emphasized, training alone is not sufficient to initiate an effective applied KM program in a tactical unit. Some form of follow-on consultation with, and sample product support to, the receiving organization is necessary for successful program start-up. Solid command support also is essential to getting an effective applied KM program up and running. For example, during an interview session following the KMRC, one of the KMRs was questioned about the potential success of the program. He noted that "If the commander wants it to happen, it will happen. If the commander has other priorities, it probably won't take hold".

Recommendation: The MCCoE and KM Proponent should further pursue the implementation of prepackaged KM model solutions (i.e., "school" solutions) that a receiving organization can use to quickly get the program started. Solutions should include templates (SharePoint, Microsoft Office, Command Post of the Future Pasteboards, etc.), SOP examples, and sample TTPs. These products along with follow-on consultation will enable a receiving unit to customize the program to fit organizational circumstances and capabilities. Such templates could give the receiving organization a concrete stating point from which to tailor their own applied KM program.

Observation: Units tend to have a separate SOP or SOP Annex for KM that describes their processes and procedures for IM.

Recommendation: The KM Proponent should express in doctrine that information flows, information structure, information products, and information displays be incorporated into the main body of the unit SOP or in the applicable functional

areas of the SOP. The KM SOP or SOP Annex should contain only the administrative details of the unit's KM program.

Observation: A number of the KM Maturity Model's assessment criteria are subjective, which can lead to a misrepresentation of a unit's actual level of KM maturity and uncertainty regarding specific directions for KM improvements.

Recommendation: The KM proponent should develop objective measures of the maturity of a unit's KM program. These objective measures should include the number of KMOs and KMRs along with their recommended positions and level of prior training and experience. Such objective measures would provide a more accurate assessment of a unit's KM maturity. Equipped with a more objective Maturity Model, the KM proponent could then develop prioritized, action-focused paths for improving a unit's KM proficiency. These paths should be formulated to lay out the incremental steps necessary to move up the KM maturity scale (from Level 1 to 2, from Level 2 to 3, etc.).

Observation: The 2/1 AD experienced challenges disseminating information and managing knowledge with coalition partners. Currently, coalition KM integration is not part of the curriculum of any of the Army's KM courses or as part of the Mission Command Digital Master Gunner course.

Recommendation: Army organizations responsible for developing coalition interoperability standards (ABCA [American, British, Canadian, Australian, and New Zealand Armies] Program; North Atlantic Treaty Organization [NATO]; Multilateral Interoperability Program [MIP]; etc.) should develop course modules for incorporation into existing Army KM courses.

Observation: ABCA has not developed TTPs for integrating coalition partners into operations. Current doctrine and standards are primarily conceptual ideas and general guidance. Soldiers need supporting concrete examples, check lists, templates, and TTPs to apply this conceptual material.

Recommendation. Army organizations responsible for developing coalition interoperability standards (ABCA, NATO, MIP, etc.) should develop TTPs providing detailed instructions for the Army's implementation of coalition interoperability standards. Soldiers should have reference manuals that describe various ways of moving and displaying known information exchange requirements with known (i.e., ABCA and NATO) coalition partners.

Observation: Army tactical units do not often train with coalition forces. Therefore, they lack practical experience integrating with coalition forces.

Recommendation. When practical, Army training events should include coalition partners. It is unreasonable to expect that effective coalition KM integration will be obtained without vetted procedures and extensive practice in applying those procedures.

3.3 Discussion

So how should the issue of enhancing KM proficiency in tactical units be approached going forward? Beyond the results and discussion presented previously, there are several additional observations and lessons from the applied KM demonstration project in 2/1 AD during AWA 17.1 that have some relevance to this question.

First, the demonstration project in 2/1 AD during AWA 17.1 did not provide a suitable basis for an assessment of the KM Proponent's approach to enhancing KM proficiency in tactical units. The demonstration project provided sparse evidence concerning the effectiveness of any of the KM-related courses, the utility of the KMWG concept, or the program's impact on mission command or unit performance.

That said, the difficulty of implementing a successful applied KM program in a tactical unit such as 2/1 AD should not be underestimated. Considerable time, preliminary work, and sustained effort on the part of the unit—along with a high level of command involvement and support—are necessary for an applied KM program to be successful. Attempting to get an intervention, such as applied KM implemented in parallel with the run-up to an intense and demanding event such as an AWA, meant that the unit could not devote sufficient time or personnel resources to get the program up and running within the time and resources allocated. Future attempts to assess KM program effectiveness should be made in a tactical unit willing and able to devote the time and resources necessary for a fair and valid assessment of the program's merits and to suggest potential areas for improvement.

A second caution regarding applied KM programs is that research results from examining KM implementation in private-sector organizations are not positive, for example Vanini and Bochert (2014) reported that only 1/6 of all private-sector KM initiatives were judged to contribute significantly to corporate success within the first 2 years after their implementation. Consequently, the majority of private-sector KM initiatives eventually are abandoned as "unproductive". Experience outside the Army also has indicated that applied KM programs are difficult to sustain, particularly in organizations having high personnel turnover. This latter point is significant because Army tactical units in general and battle staffs in particular have high levels of personnel turnover. For example, Thompson et al. (1991) reported

that the average tenure of battle staff members in the units they studied was 4.6 months. These results suggest that the potential for KM program "success" is not substantially different from other organizational interventions such as Total Quality Management or Lean Six Sigma. For a variety of reasons, most organizations struggle to make such interventions pay off (Schein 2004).

Results from across a number of venues suggest that IM proficiency (the crux of an applied KM program) is an important contributor to mission command effectiveness (Howse and Cross 1999; MCTPTDAWE 2014). This is particularly true for an increasingly information-intensive setting such as network-enabled mission command. These same results also indicate that Army tactical units typically do not do an adequate job of IM, and that IM "gap" affects mission command and unit performance. Hawley and Swehla's (2016) observations across multiple NIEs support these earlier results. The KM Proponent's current approach to implementing applied KM in tactical units represents one potential way to enhance the IM proficiency of tactical units. However, as results from the applied KM demonstration effort during AWA 17.1 indicated, focused and sustained unit effort after initial program implementation are critical to program success.

In an experimental study of IM practices in operations centers, Howse and Cross (1999) reported results suggesting that the best way to improve IM performance in digitized operations centers was to incorporate IM skills directly into the routine training provided to battle staff members. Specific areas of training emphasis mentioned in this regard included 1) distribution of IM activities and responsibilities across members of the battle staff, 2) procedures for screening incoming information, and 3) proactive anticipation of information needs. Beyond these staff-focused skill development areas, these authors' results also stressed the need to specify 1) the manner in which each digital subsystem of the digitized mission command suite should be used in IM, 2) the unique capabilities of each subsystem to support IM, and 3) efficient transfer of data across mission command subsystems.

Howse and Cross's conclusions are similar to those provided initially in Hawley (2015) and followed up in Hawley and Swehla (2016). Hawley (2015) described and discussed the effects of KM/IM "breakdowns" in NIE CPs that contributed to battle-staff sensemaking deficiencies. Sensemaking is defined as a motivated, continuous effort to understand connections to understand their trajectory and act effectively (Klein et al. 2006). Sensemaking is the foundation of situation awareness, a key enabler of mission command effectiveness. Hawley and Swehla (2016) reported results indicating that the battle staffs observed during the NIEs were not sufficiently trained (individually or collectively) or experienced enough to achieve the level of staff integration essential for effective IM. The O/C Drop

Card cited previously indicated, for example, that the brigade was "piecemealing" the fight. That is, each mission command staff component within the CP was operating semi-autonomously with little overall coordination by the battle staff. Similar observation regarding synchronization of battle staff activities has also been reported in other sources (see, for example, MCTPTDAWE 2014). Effective battle staff integration is an essential prerequisite for effective IM, staff synchronization, and battle tracking (Sauer 1996).

Hawley and Swehla (2016) also suggested that IM, and to some extent applied KM, might best be approached as an aspect of what they termed operational integration. Recall from the Introduction that operational integration refers to incorporating new materiel into CP and mission command processes and procedures as well as adjusting existing processes and procedures to reflect the capabilities of new systems and technologies. The central idea is to emphasize means for the effective use of new materiel to efficiently manage the wealth of data provided by those capabilities. It has been noted that new technology often changes the nature of the work that technology is intended to support. This statement also applies to IM practices in modernizing CPs. New systems and capabilities will change how tactical units can and should approach KM/IM in their CPs.

As noted, another important aspect of KM in tactical units involves maintaining a core of unit expertise over time as personnel arrive at and depart the unit. This represents an important aspect of KM-related performance management at the intersection of unit training and local personnel management. The glue that holds systems of systems such as a CP together and makes them more than a collection of hardware is Soldier expertise. However, there are high rates of personnel turnover in all military organizations. The human parts keep passing through the system, so to speak. Thus, even though a unit is combat-ready one day, it may not be combat-ready the next day unless the expertise of the personnel departing is continually replaced by the newly acquired skills of those who have recently arrived. This high turnover rate of personnel and the need for continual replenishment of expertise is an important consideration in unit training planning and local personnel management.

Maintaining essential levels of unit expertise in critical areas such as KM cannot be left solely to the whims of the Army's formal personnel assignment system. Units must be proactive in managing available KM expertise, as with any other critical resource. During discussions of this topic with brigade and battalion staff members, they remarked that maintaining a consistent level of expertise in key functional areas is a difficult challenge for a unit's leadership. Loss of a few key specialists often has a significant impact on the unit's performance capabilities—single points of personnel-related performance risk. That said, it is important for commanders

and senior staff to carefully plan for staffing the unit's KM function in terms of battle rostering, longevity, training, priority back fill, and alternate personnel.

Enhancing and maintaining KM/IM proficiency in network-enabled CPs is a tough challenge. Extensive training, guidance, product support, battle staff continuity, and relevant practice by the battle staff working as a team are required for effective performance. That being the case, increased use of information automation is often suggested as a solution to information overload and KM/IM problems in modernizing CPs (see, for example, MCCTS 2016). Information automation refers to automating data- and information-handling activities in fast-paced information-rich settings such as a network-enabled CP (Billings 1996). The idea behind the push to use automation to relieve the battle staff of the demands associated with KM/IM can be summarized as follows: "Just automate the information handling requirements in modernizing CPs, and we'll be relieved of most if not all the training and human performance demands associated with effective KM or IM. These new systems will take care of that for us". Under such an approach, various software applications would be used to assist (or replace) the battle staff in performing IM processes. Information automation support might take the form of a standalone support system referred to as a Commander's Assistant or Commander's Toolkit (or something similar), or might be embedded in the software of an existing mission command system.

Increased use of information automation has the potential to be beneficial in many ways and enable CP operations that otherwise might be difficult to support. However, caution is suggested because information automation can have negative side effects if not implemented properly. For example, a recent Federal Aviation Administration (FAA) report noted that information automation improperly applied in automated flight management systems could increase pilot workload, increase head-down time, distract the flight crew from higher priority tasks, and contribute to crew communication and coordination issues (FAA 2013). Moreover, IM vulnerabilities can occur, especially if users are not aware of assumptions made in the support system's design or if the information presented to users is not fully understood. Used in this context, the term "vulnerability" refers to characteristics or issues that render a system or process more likely to break down or fail when faced with unusual or ambiguous situations. This downside of automated system performance is often referred to as the "brittleness problem of automata" (Hollnagel and Woods 2005).

These cautions from the flight management arena are relevant to providing automated support for the KM/IM activities that take place within contemporary CPs. The idea that information automation can be used as a simple replacement for Soldier KM/IM responsibilities exemplifies one of the "deadly myths" associated

with automated systems (Bradshaw et al. 2013). Another persistent myth associated with automation is that its use will lessen user training requirements. A wealth of human factors research and operational experience indicates that such is not always the case. The more usual result is that automation increases training requirements to match the added complexity often associated with automated systems (see, for example, Bainbridge 1983).

Automation can be used to supplement and extend human capabilities but not substitute for them (see, for example, Wickens et al. 2013). But even then, providing automated support to a function such as KM/IM must be approached cautiously and with a solid understanding of how a proficient battle staff uses (or might use) incoming data to generate the information (data in context) necessary to support command decision making (see, for example, MCCTS 2016). So-called "clumsy automation" can make Soldier tasks more and not less demanding. Clumsy automation refers to automation that is improperly designed or does not take into consideration how the tasks performed in a cognitive work system such as a CP are actually performed or might change with the addition of that automated support (Woods 1996).

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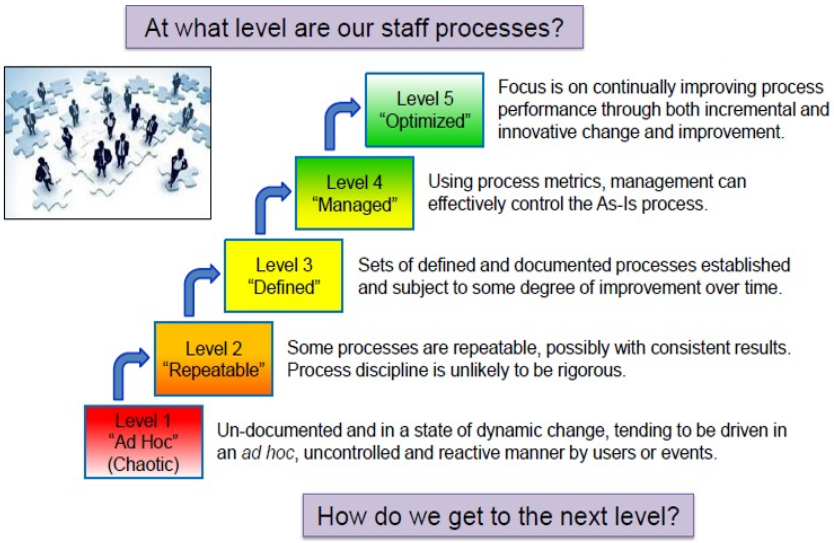
Appendix A. Army Knowledge Management Introduction to the KM Maturity Model Tool

This appendix appears in its original form, without editorial change.

A.1 Background/Purpose

The purpose of this document is to introduce to Army Knowledge Management (KM) practitioners a tool that is being developed to facilitate assessing the maturity of a KM program. KM has been a part of the United States Army since 2004 with the founding of the Battle Command Knowledge System (BCKS) at the Combined Arms Center at Ft. Leavenworth, KS. BCKS as an organization was reorganized into the Army Knowledge Management Proponent Office and Army KM doctrine has matured and is deeply embedded in the Mission Command Warfighting Function as a key staff task which is articulated in ADP 6.0 *Mission Command*. Since 2009 the Army Knowledge Management Proponent Office has trained approximately 500 students in the KM process and in March 2015, published the Army Techniques Publication (ATP) 6-01.1, *Techniques for Effective Knowledge Management*. As the Army continues to expand its KM footprint, the need for KM practitioner tools increases. This document contains an overview of the Maturity Model tool and how to use it.



First, the idea of KM Maturity is not new. There are several models developed in the private sector, namely by two organizations: Carnegie-Melon and American Productivity and Quality Center (APQC). Both of these models have made their way into various Army organizations and are undergoing their own "pilot" as well. In 2009, the US Army War College published a paper addressing the need for an Army version of a KM Maturity Model and with it a concept of what it might look like. Using that document as a basis, the AKM Maturity model was expanded as described in this paper and when used by a unit will provide a baseline assessment of a KM program. Second, the objective of this tool is to provide an organizational aid to improving organizational effectiveness and is not intended as an inspection

item. Most importantly, the tool is designed as an enabler for the KM team to help the organization execute Mission Command more effectively.

A.2 How to Use the Maturity Model Tool

The tool has a list of "efforts" that can be scored using a simple Likert Scale of 1–5 (an effort is a term borrowed from the Mission Command Information System called Command Post of the Future). Each effort is grouped under the four components of KM: people, process, tools, and organization and there are a total of 42 efforts. Efforts may be related to other efforts in other components as well. TAB 1 of the tool contains a description of what the effort is and TAB 2 contains information on how each effort contributes to KM maturity, as well as suggested reference material that will aid in improving the score.

For example, an effort listed under the people component is called "Terms of Reference" (TOR). A TOR document is an emerging TTP that contains a short summary of key people within an organization and their specific roles and responsibilities within the command structure. This contributes to KM maturity in that a well-developed TOR document eliminates any confusion as to who reports to whom and more specifically, enhances shared understanding regarding roles and responsibilities. It is an effective emerging best practice.

A.3 Maturity Tool Worksheet

KM Maturity Model Worksheet (v1.0)

KM Principles: Undertand, Share, Integrate, Connect, Learn, Trust

Range: 1=Not doing it, 5=Validated Effort (rate unit/organization for level of implementation of each effort)

A	Score	B	Score	C	Score	D	Score
People				**Tools**		**Organization/Culture**	
Terms of Reference			2	IM Tools	2	Culture of Collaboration	2
KM Roles and Responsibilities			2	Collaboration Tools	2	Communities of Purpose	2
Battle Rosters		ews	2	Lessons Learned Repositories	2	Organizational Trust	2
KMWG	2	KM/Staff Rehearals	2	KM SOP	2	KM Vision	2
External SMEs	2	KM Process	2	KM Strategy	2	Learning Environment	2
KMRs	2	KM/IM Tools Training	2	Validated COP	2	Cohesive Teams	2
		CCIR/SIR Management	2	KM Planning (Annex Q)	2	Social Interaction	2
		Operations Process	2	Battle Rhythm	2	Organizational Feedback	2
		COP/Dashboard Management	2	Working Groups and Boards	2	Mission Command	2
		Time Management	2	PACE Plan	2	KM Chain of Command	2
		Lessons Learned Management	2	Learning Tools	2		
		Task Management	2	Expertise Location System	2		
				Virtual Communities	2		
				ORG SOPS/Policies	2		
Column Total (Max =30 Points)	**12**	**Column Total (Max =60 Points)**	**24**	**Column Total (Max =70 Points)**	**28**	**Column Total (Max =50 Points)**	**20**

Existence of a Terms of Reference Document and frequency of update (i.e. each mission)

A.4 The Rating Scale

The Likert scale of 1–5 is used as a way to standardize and quantify the ratings. The scale is universal to every effort, meaning a separate set of metrics is not needed for each effort. Either you are doing it, doing it to some level of proficiency (substitute the term maturity here), or you are not doing it at all. Essentially, all the efforts identified were chosen because they were either a doctrinal requirement or an emerging "KM best practice". It should be noted that Army units at all levels, including generating and operating forces, are required to execute Mission Command. Each effort is linked to Mission Command doctrinally. Based on that, the tool helps to identify and assess activities related to KM that the organization needs to be doing well, particularly as it relates to the execution of Mission Command. The scale is intended to answer three key questions:

1) Is the unit even doing this effort?
2) If so, is it in some stage of development?
3) Is it codified and validated in daily practices?

All efforts are scored using the below rating scale:

Rating (1-5)	Description/Metric	
1	Unit is not doing this effort at all	Minimum
2	Unit has started this effort but is still in development	
3	Effort is well developed but not fully implemented	
4	Unit does this effort and it is fully implemented	
5	Unit has assessed the effort and has validated its utility	Maximum

To use the tool, open the spreadsheet and click on Tab 1- KM Maturity Worksheet. Rate each effort using the dropdown menu (instructions are on the lower left). Evaluate all 42 efforts and score them individually. The goal of the tool is to end up with an overall maturity rating as a baseline. This can be done by an individual Knowledge Manager, or collectively with the Knowledge Management Working Group (KMWG). The tool automatically calculates the total maturity for each KM component, then provides an overall maturity score of 1-5.

To find additional information about each effort and its relationship to KM, click on Tab–2 References. Scroll down to find the effort you need additional information. On the far right column is a list of potential resources that you can research about the effort.

A.5 What You Should Do with the Results

Every unit has to start their KM program somewhere, and some of the efforts are geared towards getting the program off the ground (i.e. establishing a KMWG, or developing a KM SOP). For many of the efforts, the unit is already doing the effort (i.e. managing CCIRs, or developing a Common Operating Picture). This tool allows the KM team to assess and quantify how well. The five step KM process starts with assess, (followed by design, develop, pilot, and implement). Intended use of this tool is in the assessment phase. Therefore, if the KM program is just getting started, the focus should be on the efforts that are specific to implementing the program. Use the results from this initial assessment to develop a priority list to improve the unit's ability to more effectively execute Mission Command. Then periodically conduct reassessments. Finally, enter the date and the score on the right hand side of the sheet to mark progress. Good luck!

Unit/Organization			
KM COMPONENT SCORE		MAX SCORE	MI
People	15	30	2.5
Process	25	60	2.08333
Tools	35	70	2.5
Organization/Culture	21	50	2.1
TOTAL KM MATURITY SCORE	96	190	51%

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Appendix B. Post Knowledge Management Representative Course Training Evaluation Questionnaire Knowledge Management Training Experience

This appendix appears in its original form, without editorial change.

Quality of experience	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1. I now have a better understanding of what knowledge management (KM) provides	1	2	3	4	5
2. I better understand how the people, processes, and tool components of KM support the organization.	1	2	3	4	5
3. I better understand how knowledge flows to create shared understanding.	1	2	3	4	5
4. I better understand how KM supports the operations process	1	2	3	4	5
5. I better understand how to apply the KM process within my staff position and role.	1	2	3	4	5
6. I better understand the different roles and responsibilities of people (Soldier, KMO, KMR, CoS, etc.) in the KM process.	1	2	3	4	5
7. I better understand vertical and horizontal collaboration.	1	2	3	4	5
8. I believe this training will enable better information sharing throughout my unit.	1	2	3	4	5
9. I better understand how to leverage tools that enable information sharing.	1	2	3	4	5
10. I believe I can use the knowledge gained in training to assist in creating, executing, and evaluating a KM unit plan.	1	2	3	4	5
11. I believe training prepared me to use the KM maturity model to conduct a unit KM assessment.	1	2	3	4	5
12. I believe the KM maturity model can assist me in identifying knowledge sharing weaknesses in my unit.	1	2	3	4	5
13. I believe my leaders will embrace KM to better our unit shared understanding and collaboration.	1	2	3	4	5

List of Symbols, Abbreviations, and Acronyms

2/1 AD	2nd Brigade Combat Team of the 1st Armored Division
ABCA	American, British, Canadian, Australian, and New Zealand Armies Program
ARL	US Army Research Laboratory
AWA	Army Warfighting Assessment
BCKS	Battle Command Knowledge System
BDE	brigade
BMC	Brigade Modernization Command
CDR	commander
CO	commanding officer
COIN	counterinsurgency
COP	Common Operating Picture
CP	command post
CTC	Combat Training Center
CW2	Chief Warrant Officer 2
DA	Department of the Army
DOTLP	Doctrine, Organization, Training, Leadership and Education, and Personnel
FA	Functional Area
FAA	Federal Aviation Administration
HSI	Human–Systems Integration
HRED	Human Research and Engineering Directorate
IM	information management
IT	information technology
KM	knowledge management
KM/IM	knowledge and information management

KMO	Knowledge Management Officer
KMR	Knowledge Management Representative
KMQC	Knowledge Management Qualification Course
KMRC	Knowledge Management Representative Course
KMWG	Knowledge Management Working Group
MCCoE	Mission Command Center of Excellence
MIP	Multilateral Interoperability Program
MTOE	Modified Table of Organization and Equipment
NATO	North Atlantic Treaty Organization
NCO	noncommissioned officer
NIE	Network Integration Evaluation
O-3	captain
O-4	major
O/C	Observer/Controller
S-3	operations and training
S-6	signal
SA	Situation Awareness
SLEO	Senior Leader Executive Overview
SOP	standard operating procedure
SME	subject matter expert
TOC	Tactical Operations Center
TOR	Terms of Reference.
TTPs	tactics, techniques, and procedures
XO	executive officer

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RDRL HRB C
J GRYNOVICKI
RDRL HRB D
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A DECOSTANZA
RDRL HRF B
A EVANS
RDRL HRF C
J GASTON
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