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A STEP TOWARDS AN INTELLIGENT DIGITAL TRAINING MANAGEMENT SYSTEM (I-DTMS)

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The Graduate Program in Applied Computer Science

A Step towards an Intelligent Digital Training Management System (I-DTMS)

A Thesis in

Applied Computer Science

By

Andrew A. Dugger

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Master of Science

July 2016

I have submitted this thesis in partial fulfillment of the requirements for the degree of Master of Science

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Contents:

Abstract

The U.S. Army Digital Training Management System (DTMS) is a web-based system designed to create a single point of entry for units to schedule unit training, manage training resources, and create schedules and master calendars for training. Currently, the U.S. Army uses DTMS to manage unit training and help commanders at each step of the training management process from planning and preparing to execute and assessing the training plans. This research aims to add intelligent features to DTMS through augmenting it with an intelligent decision support system (ITPSS) that utilizes artificial intelligence techniques (case-based reasoning, in particular) to determine if training guidance (either annual training guidance or doctrinal template) was implemented correctly. The proposed system should also help company commanders to refine their unit training plans after reviewing previous similar unit training plans recommended or retrieved by the ITPSS. This research demonstrates how case-based reasoning could improve the training plan development and approval process in DTMS, and questionnaire results support this analysis. It is worth noting that the focus of this research is on the applicability and plausibility of the proposed decision system, not on developing an interface between DTMS and DSS.

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Acknowledgment

This thesis would not have been possible without the support of many people that I would like to recognize. I would like to thank my family who has provided steadfast, loving support throughout my Master's study. My work on this dissertation could not have been possible without the help, support and guidance of my thesis supervisor Dr. Rania Hodhod. I would also like to thank Dr. Rodrigo Obando, Dr. Shamim Khan and LTC Heath McCormick for serving on my thesis committee. Also, I especially appreciate the DTMS subject matter experts at Fort Leavenworth for their support, feedback and their assistance with the research study.

1. Introduction

Large organizations and systems adapt to change (including new technology) or fail. This maxim includes the integration of new technology into old systems that will be eventually be replaced by new systems and applies to the U.S. Army's Training Management System (ATMS) and Digital Training Management System (DTMS). The Army's Training Management System (ATMS) supports the Unit Training Management (UTM) process to enable and ensure that "Training is the primary focus of a unit when not deployed" [1]. ATMS includes DTMS, the Army Training Network (ATN), and the Combined Arms Training Strategy (CATS).

DTMS is a part of the "…Army Training Management System (ATMS) (DTMS, Army Training Network, CATS) to plan, resource, and manage unit training and access Army standard training products" [2]. DTMS will, as a part of long-range planning efforts, and future systems development, have Artificial Intelligence techniques integrated into the Army Training Management System (ATMS) that "Leverage ongoing research in artificial intelligence, adaptive learning systems, virtual training and human performance measurement technology" [3].

Based on that guidance, it is necessary to understand what DTMS is and where it fits into the training management process. DTMS is a "...web-based system is designed to link existing systems to create a single point of entry for units to schedule unit training, manage training resources, and create schedules and master calendars for training" [4]. DTMS was developed by nFocus and uses a .net SQL data structure [8]. Currently, the U.S. Army uses the DTMS to manage unit training where DTMS is considered a premier training management tool that "…helps commanders at each step of the training management process from the plan and prepare to execute and assess" [5]. Another aspect of DTMS is that it is a program of record and usage at every echelon as mandated by Army Regulation, "To assist commanders, DTMS (Web-based) is

the system that will be used to track and schedule training and provide summary reports to assist in determining individual and collective skill proficiency for assessing unit overall training" [6]. Currently, a unit's (Brigade, Battalion, or Company) long range training calendar is planned in DTMS.

According to the literature reviewed for this research and discussions with ATMS personnel at Fort Leavenworth, DTMS is a vital planning tool for the US Army. On the other hand, the Deputy Director of the Training Management Directorate at Fort Leavenworth stated that DTMS does not currently provide a way for a leader to check subordinate unit planned training events in support of a unit's long-range training schedule or gated training strategy against a "perfect plan" [7]. Additionally, this is supported by a guidance memorandum outlined in June 2014, which supports a lack of intelligent behavior in DTMS due to not being in the scope of requested capabilities [8]. Case-based reasoning (CBR) seems to be a suitable artificial intelligence technique that can allow an automatic check of how close executed plans are to a desired perfect plan.

CBR, generally speaking, is the process of solving new problems by remembering (for a human) or retrieving (for a computer) a previous way that worked, called a case, to identify similar ways through reasoning that may apply or are similar to the new problem. Humans use this type of reasoning daily based on their experience learned from other similar situations (cooking, fixing cars, etc.). A key component to using computers to solve a new problem is an accurate case base that can be queried based on concrete case attributes [9]. At the highest level of generality, a general CBR cycle may be described by the following four processes [10]:

- **Retrieve** the most similar case or cases,
- **Reuse** the information and knowledge in that case to solve the problem,

- **Revise** the proposed solution,

- **Retain** the parts of this experience to be useful for future problem solving.

Developing a decision support system that uses CBR methodology allows a user or commander, in this case, to automatically validate the performance of past plans against future plans in DTMS. This feature should support commanders and staff at all echelons. The proposed DSS provides a way to compare a recently implemented unit training plan (UTP) from DTMS to the perfect plan or "perfect solution" from the Combined Arms Training Strategy (CATS). This retrieval provides commanders with a way to compare their plan to other units' similar plans (training cycles). An example of this process is a unit that receives a change of mission and has to rewrite their training plan for a new area of operations. Based on discussions with ATMS personnel, the timing of this study is good due to the ATMS Requirements Control Board (RCB) Work Group who met 3-5 MAY 2016 to discuss evolving ATMS functionality and integrate new requirements [11]. This study does not focus on modifying the current capabilities of DTMS directly, but as a proof of concept due to DTMS being a secure "live" system.

1.1 The Unit Training Management Process

DTMS supports the Unit Training Management (UTM) process which "…is the process commanders, leaders, and staff uses to plan-prepare-execute-assess unit training and leader development." UTM also helps identify the resources needed to conduct effective, performance-based training and leader development [12]. For this thesis, a discussion on Unit Training Plan development and approval are not germane due to the case base consisting of already approved unit training plans.

The training management process has the following phases as shown in Figure 1, below:

Phase 1 – Plan – The planning phase includes the planning of a training event far enough out in the training cycle to be able to lock in resources needed for successful execution of the training event in accordance with the commander's intent to train on key collective tasks (KCT) [11]. The commander is a key part of this process and that explains why the commander is shown as the central hub for this process in Figure 1.

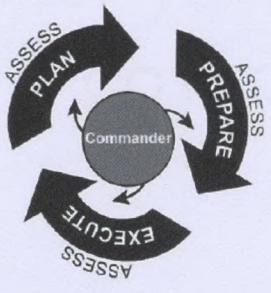

Figure 1. The Operations Process, adopted from [12, p.11 (Figure 1-2)]

The planning phase includes an assessment of the KCTs to determine whether a unit will conduct a training event at a crawl, walk or run level based on that unit's proficiency on the KCTs and their assessment. This process helps in the identification of necessary resources for the training event.

Phase 2 – Prepare – The prepare phase for a training event is no different than planning an operation. Resource planning and coordination must occur early to ensure that the correct resource is available at the right time and right place so that the training event is meaningful and effective [12]. Different resources have to be coordinated early enough in the training cycle, i.e. training area lock-in may occur 60 days out, but ammunition lock-in may occur 90 days out from execution.

Phase 3 – Execute – The execute phase includes rehearsals, and pre-combat checks and inspections, time for the execution of the training event, and time to retrain a training event on the

Unit Training Plan [12]. By executing a training event that has been properly planned, resourced, and coordinated the unit will finish the training event with a higher rating in key collective task training proficiency.

Step 4 – Assess – The assessment phase is an ongoing process that occurs before, during, and after training events and training cycles or training phases (see Figure 1, above). The after action review (AAR) is a critical aspect of the assess process and an AAR is conducted at the end of each training event. Based on this AAR, the unit can determine how well they performed during the training event on their key collective tasks, and this evaluation is the basis of the next training event plan as a part of the crawl, walk, and run methodology. The assess phase is not a standalone phase but is a part of each step of the unit training management or operations process.

Figure 2. Development of the Unit Training Plan (UTP), adapted from [12, p.10]

The unit training plan is an output of the UTM process. The UTM is applied to every unit in the Army focusing on developing, approving, and executing UTPs. UTMs will be used to build the case repository of our decision-based system where one case will represent each UTP. The UTPs used for this research are already developed and approved unit training plans (see Figure 2). The results from this thesis will act as a proof of concept and will help determine the plausibility of adding artificial intelligence into future versions of DTMS through leaders' feedback on the proposed system.

1.2 Case-based Reasoning

The Case-based reasoning cycle consists of four phases: Retrieve, Reuse, Revise, and Retain (R4) [13]. "The CBR process requires cases that consist of problem and solution description." [16, p. 1]. However, "in tackling a real-world problem with an AI solution, it is not uncommon to find that a single AI system fails to meet all the requirements for solving the problem." [17, p. 196].

Case-based reasoning can utilize numerous types of algorithms to retrieve similar cases from the case base to a query case. Examples include clustering algorithms such as k-Means and DBSCAN[14], case similarity algorithms such as k-nearest neighborhood (k-NN), where k is the number of most similar cases[15] or Nearest Neighbor (NN), which are applied in the retrieval step of the CBR process.

1.3 Contribution to the State of the Art

ATMS consists of three major tools that support the Unit Training Management Process: DTMS (Digital Training Management System), CATS (Combined Arms Training Strategy), ATN (Army Training Network). Units (Division, Brigade, Battalion, and Company) use the Unit Training Management Process to implement ATMS into action. This research focuses on enhancing unit training plans in DTMS.

Although DTMS is a good planning tool, it does not exhibit any intelligence as it cannot aid or provide suggestions to commanders during the planning of training events. While the DTMS system is a helpful tool, the interjection of artificial intelligence would be beneficial to support users by providing an evaluation and retrieval methodology in support of planning. ITPSS (Intelligent Training Plan Support System) is a proposed system that uses maneuver

company training plans from one Division to develop a case repository. Battalion commanders and above could use DTMS as a tool that allows them to see current, proposed plans, and automate a previously manual evaluation of those plans during the approval process. An intelligent support system called ITPSS is developed for the purpose of this research to augment the current capabilities of DTMS so that it can exhibit that desired intelligent behavior.

1.4 Thesis Outline

This thesis is organized as follows: The following chapter is the related works section covering decision support systems that have used case-based reasoning. Chapter 3 discusses the current research and the proposed decision support system, including the system architecture, design, and development. Chapter 4 presents the empirical evaluation section and finally, Chapter 5 provides a discussion and conclusion of this work.

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2. Related Works

The U.S. Army provides guidance on Unit Training Management. The Army does this through the implementation of numerous documents: Army Doctrine and Training Publications (ADP), Army Doctrine Reference Publications (ADRP), Field Manuals (FM), Pamphlets (PAM), and Army Regulations (AR). However, the integration of artificial intelligence techniques is not found as a part of current U.S. Army systems or doctrine.

The Combined Army Center – Training (CAC-T) publishes a quarterly online magazine called Army Training Quarterly that is posted on the Army Training Network (ATN) website [18]. This magazine addresses current training areas of emphasis that CAC-T has purview over which impacts training across the entire force. Examples of topics from the Spring 2016 magazine include discussions of the following:

1. Integrating the Live, Virtual, Constructive – Integrating Architecture (LVC-IA) into training at the Joint Multinational Readiness Center (JMRC).
2. Supporting training in an uncertain environment by sharing best practices of unit's usage of the Integrated Training Environment (ITE) and training aids, devices simulators, and simulations (TADSS).
3. Army Training Management Systems.

The authors discuss the Army Training Management System and the Unit Training Management process in detail to provide leadership examples, best practices, and digital training tools to the Army. However, this article only explains or better describe the Unit Training Management Process from ADP 7.0 and the Leaders Guide to Unit Training Management [19]. The authors discuss the responsibility of leaders to develop their Unit Training Plans to account for a crawl-walk-run methodology and that the current digital tools (CATS and DTMS) make this

process easier. In [20], the NATO Education and Individual Training Directive establishes the guidance for the use of a Training Management System called e-NATO for Education and Training but the training management process is not the same as the U.S. Army's Unit Training Management Process, and it does not integrate any artificial intelligent techniques.

The Training Management Process and the Operations Process are the same process and remain a key part of developing unit training plans by doctrine and a crawl-walk-run methodology [21]. This formalized structured process allows it to be used for decision support to commanders as they "…operationalize their intent and vision for unit-level training and recapture the art of training management [19]." By implementing a crawl-walk-run methodology, units ensure that training is iterative, progressive, and commander focused [21]. This research focuses on the military and civilian integration of decision support systems (DSS) and more specifically on DSS that utilize case-based reasoning (CBR) to support the training management online resources of the Army Training Management System (ATMS). Case-based reasoning as discussed by the author of [22] is "…a model of reasoning that incorporates problem-solving, understanding, and learning and integrates all with memory process."[23, p.5]. CBR applicability crosses many domains, but the backbone of CBR is the R4 process (defined in the next paragraph) that queries an accurate case base using attributes as the query values for the retrieval phase.

Research on DSS that uses CBR has been an active and important research area for more than the last 20 years, but even though this research area has been applied in medicine, water distribution, the courtroom, oil drilling, military decision support simulation systems, and strategic decision support it has not been implemented into the U.S. Army's mission command, training management systems, or TADSS. The remainder of this section will focus on a discussion on the research of military decision support systems, decision support systems with

knowledge management or modeling, and case-based reasoning decision support systems based on similar applications.

2.1 Case-based Decision Support Systems

"Military actions are complex situations occurring in complex environments. Therefore, the decisions taken in this field must be treated in a complex manner." [23, p.135]. The complexity and the continuously changing environment caused by the force on force operations are not able to be replicated in the real world repeatedly enough for a decision support system to be tested other than in a modeling and simulation environment. Therefore, it is not surprising that the focus is on modeling and simulation exercises for the majority of decision support system applications that support commander's decisions. In [24], the authors implemented a DSS that utilized CBR and a Bayesian Belief Network (BBN) for military decision making that focused on critical success factors identification to attempt to declutter the information from the battlefield using information superiority. The critical success factors, once identified, were the input into the BBN. Given the richness and complexity of the military domain made the modeling of scenarios in the case base difficult [24, p. 8232]. This demonstrates the challenge with implementing an artificial intelligence solution. The authors' system used the k-NN algorithm for the case based reasoning that focused on the distance between cases to attempt to implement the DSS, but the real time data acquisition proved to be a challenge when trying to turn uniquely identified features into a case for recommending a decision. This DSS was able to identify the critical success factors to aid in situational awareness, but the authors believe this system is a better fit for wargaming, not practical for real-time decision support [24].

In [25], the authors implemented a case-based decision support system (CBDSS) that focused on supporting military command and control by using the standard operating procedure to match to the current situation or the new problem and the case base. This system demonstrated through testing an increase in subjects who won their games using the CBDSS[25]. Nonetheless, this system also found that the dynamic ever changing environment proved too much of a challenge for their CBDSS to demonstrate consistently reliable decisions. Similarly, the author of [26] found this to be true as well. Since most military decision support systems focus on modeling and simulation to try to provide real-time decision support, expanding the research was needed. Of note, what was not found during research was military case based reasoning implementation in support of training management systems.

When researching decision support systems with knowledge management or modeling that use case-based reasoning, an aspect that stands out is the need for domain experts and knowledge engineers who provide the expert knowledge for an accurate case base that the CBR tool can implement. This expert refinement can be considered knowledge management is an ongoing or continuous process [21]. The authors of [21] recommend establishing four knowledge containers (Vocabulary, Similarity Measures, Adaptation Knowledge, and Cases) to build a similarity based knowledge model for the CBR tool to use. myCBR is " an open source tool targeting at developing customized knowledge models with an emphasis on vocabulary and similarity measure development." [21, p.2]. myCBR's process of formulating a knowledge model is directly applicable to this thesis. In [27] the authors utilize case based reasoning with several different knowledge intensive similarity measures to improve the efficiency of the retrieval phase of the R4 process to allow a CBR system to process very large case bases efficiently. The two algorithms discussed were the NN and induction retrieval algorithms, and each algorithm has

advantages, but in the end results of this paper, both were inefficient for large case bases. Both algorithms can process knowledge intensive similarity measures, and the biggest difference between the two is whether or not a case has features that depend on other features. If this is the situation, the nearest neighbor (NN) algorithm is the preferred algorithm when features depend on features [27].

In [28] the authors discuss "…an infrastructure that enables businesses to extract, cleanse, and store vast amounts of data."[28, p.1]. The focus of the paper is knowledge management where the goal is to leverage knowledge by converting tacit to explicit knowledge or in other words, taking knowledge that is understood by an expert (riding a bicycle as a simple example), and converting it to written knowledge like writing the instructions for how to ride the bicycle for the tool to utilize. Case-based reasoning utilizes explicit knowledge, and the knowledge worker seeks to keep the best cases while removing cases that had higher failure rates. This DSS/IT/AI system improves the knowledge warehousing of data to enhance each phase of the knowledge management process for the knowledge worker updating the system [28]. This process is in a feedback loop with a validation phase of the output thus improving the AI-based data mining system. The functional requirements for knowledge warehousing are directly applicable to the U.S. Army's Digital Training Management System and will be discussed further during data analysis. In [29], the authors use electronic concept maps for building knowledge models where the primary tool being used is CmapTools that incorporates case based reasoning (Discerner) and data mining (Extender). The area focused on from this article is the case based reasoning application to knowledge modeling. Discerner is utilized for case retrieval when similar situations are presented that have been solved before, thus providing an area where CBR is applicable based on prior concept maps. Each recommendation must be approved by the user

before implementation into the concept map, and the retrieval process was based on indexing instead of textual references. The authors were encouraged by the retrieval process results and found that by broadening searches, errors were reduced and correct case retrieval was improved [29].

When researching case-based reasoning decision support systems several journal articles stood out as applicable to this thesis. First, the authors of [22] address integrating "…a case-based reasoner, a temporal reasoner, and a scheduling system."[22, p.196] with the goal of improving the planning capability of a real-world system called the "System for Operations Crisis Action Planning (SOCAP)." [22, p.196]. This level of integration is similar to the process necessary to integrate AI into DTMS once DTMS is linked to other existing systems. "This work has also paved the way for a more structured integration of using (1) a common knowledge representation language that provides an interlingua for different systems, and (2) a client/server interface mechanism that supports location-transparent interprocess communication."[22, p. 201]. The lessons learned through the integration process are applicable.

Also, looking at CBR usage for planning, the authors of [30] address CBR for marketing plans that focus on the retrieval of cases of past marketing plans "…containing strategic planning knowledge and experiences." [30, p. 43]. This system focuses on case retrieval, but the adaptation problem is left to the user for evaluation due to the difficulty with adaptation. This work uses an XML case representation and a multi-attribute decision making (MADM) retrieval method. The DSS discussed is a similar process to what this thesis presents by implementing ITPS, but the adaptation of similar cases into the current plan is the user responsibility. The strategic marketing planning application from this article based on CBR retrieval that required weighting and evaluating the similarity indices appears to have been solved by myCBR which can

incorporate similarity measures and attributes that can have attributes that can be weighted [31]. In [32], the authors address how case-based reasoning can support strategic enterprise decisions in business management where there are complexity and uncertainty, but there are lessons from previous experience or analogies present. The authors state that "….CBR does away with the classical problem of knowledge acquisition bottleneck in expert systems, as it requires a representation of the case and the solution."[32, p. 4]. For this statement to be true, the authors propose a 5 step methodology for knowledge representation that when tied to similarity measures in CBR (myCBR used) to demonstrate applicability once deciding on the correct case attributes.

The authors of [32] believe that this approach might be useful but requires further testing. In [33], the authors implement a CBR system to support courtroom decisions that proved to be efficient and effective. The attributes come from a new vehicle accident, and these attributes are the new case inputs into the system for the retrieval phase of the R4 or CBR process. Once similar cases are retrieved, a determination as to whether or not the solution is applicable is made, and due to this, police officers in England were able to implement the recommended solution 75% of the time to reduce courtroom workload from vehicle accidents. Also, this paper addressed the time necessary for the police officers to gain the trust of the system, and this took a couple of years of use to implement.

The application of case-based reasoning in the above systems demonstrate how decision support systems that use case-based reasoning already support multidisciplinary domains, but the systems discussed are limited in their lack of application to military training and their lack of an explanation capability for each case. The training domain is a good area for the implementation of a case-based reasoning solution due to training cycles repeating every 6 to 18 months based on the desired certification level that units must achieve before deploying to a combat training center

(CTC). This means that the retrieval of previous similar training cycles or cases would aid units in the planning process of home station training (HST) to improve unit training plan development. The proposed DSS utilizes case-based reasoning to implement a methodology to support Army Training Management Systems, and myCBR includes an explanation feature not present in the systems discussed above. The explanation feature of myCBR should be beneficial to future versions of DTMS after additional Army systems are linked to DTMS. The explanation feature of myCBR will be demonstrated in Chapter 3, and is another aspect that makes this decision support system a good fit into DTMS.

3. Research Goal and Methods.

Units develop long-range training plans based off of three primary areas; doctrine, mission specific pre-deployment training requirements, and Commander's Guidance which is usually codified in an Annual Training Guidance (ATG). The primary difference between the three documents is that the ATG is more mission specific based on the assigned mission of a specific unit that is preparing for operations in a specific area of operation. The training cycle for this specific mission will include deployment training requirements for that area of operation (e.g. if an Armor unit is assigned the mission of training host nation security forces in an African country, then the training cycle for that mission may not include a tank gunnery).

The ATG allows a commander to specify their training guidance and vision including the certification level a unit must achieve before deployment to a combat training center. This guidance is a key part of the Operations Process and Training Management Process. In many training cycles, a unit will find that they are conducting the same training as another similar unit that has gone through the same type of training cycle in preparation for a similar type of mission. As in the example above, units could benefit from being able to look at other units training plans in preparation for training host nation security forces in Africa. In other words, one unit should be able to find similar training plans, and utilize them as a basis for the development of their Unit Training Plan. Current versions of DTMS do not allow the viewing or querying of Unit Training Plans by other units (other than their higher headquarters). If a unit does not have an assigned area of operations that changes their training cycle to mission-specific events, then the doctrinal template from CATS is the point of departure for developing the Unit Training Plan. This research attempts to not only show how a commander or his staff could digitally check on how well subordinate units integrated training events from either an ATG or doctrinal template into

their Unit Training Plan (First Study), but also show how AI could be integrated into not only the retrieval of similar training plans to aid in the development of the Units Training Plan (Second Study).

3.1 Research Goal

This thesis aims to develop an intelligent decision support system called ITPSS that uses case-based reasoning to support training management. The proposed system attempts to use a proof of concept to demonstrate areas that need to be improved in a real-world training management system in use in the U.S. Army (DTMS).

3.2 Research Tools

There are many CBR tools available including myCBR, jCOLIBRI2, eXITCBR, and FreeCBR [34]. jCOLIBRI2 has the capability to evaluate a case base using three "…strategies: Hold Out, Leave One Out, and N-Fold." [35, p. 134]. jCOLIBRI2 also has the capability to build specialized CBR applications that include textual CBR applications, recommender systems, knowledge-intensive CBR, data intensive CBR, and distributed CBR with multiple extensions that can be integrated into other systems [35]. jCOLIBRI2 supports all four phases of the CBR cycle [35]. eXITCBR has been utilized in health care applications as an independent tool to classify and aid in diagnosis, but the current eXITCBR framework is a JAVA multiplatform tool that may also be able to aid in experimentation [36]. FreeCBR is also a JAVA framework but is stand-alone and is not as flexible as the previously discussed systems.

myCBR is an open source CBR tool that can be run on a GUI or with the SDK for software development or integration into other applications [31]. myCBR also provides

explanation support for case-based reasoning and "In object-oriented CBR systems the vocabulary consists of numerical, symbolic, plain text, and instance type attributes."[37, p. 1844]. The explanation feature of myCBR supports the knowledge manager in several ways. First, it provides two kinds of explanations, both forward and backward chaining, but second, it allows definitions to be added to each attribute in the case-base that allows nonprofessionals to understand why the knowledge engineer chose those attributes [21]. myCBR also provides for adaptation rules and this capability is being taken from a beta version to a public release version. [31].

Among the tools presented above, myCBR stood out in three ways for this DSS. First, myCBR was the only CBR tool that included an explanation feature. Second, myCBR is an open source CBR tool that allows access to the code so that developers can utilize an SDK (software development kit) or graphical user interface (GUI). Third, myCBR can utilize a rule-based system for adaptation of retrieved cases. This capability was developed in [31] but is not ready for public use yet.

3.3 ITPSS: Intelligent Training Plan Support System

The decision support system developed in this research is called ITPSS (Intelligent Training Plan Support System). ITPSS uses case-based reasoning as each training plan from maneuver companies from DTMS (XML files) seems to be naturally mapped to a case in the case repository of the system. The architecture for the ITPSS is demonstrated in Figure 3.

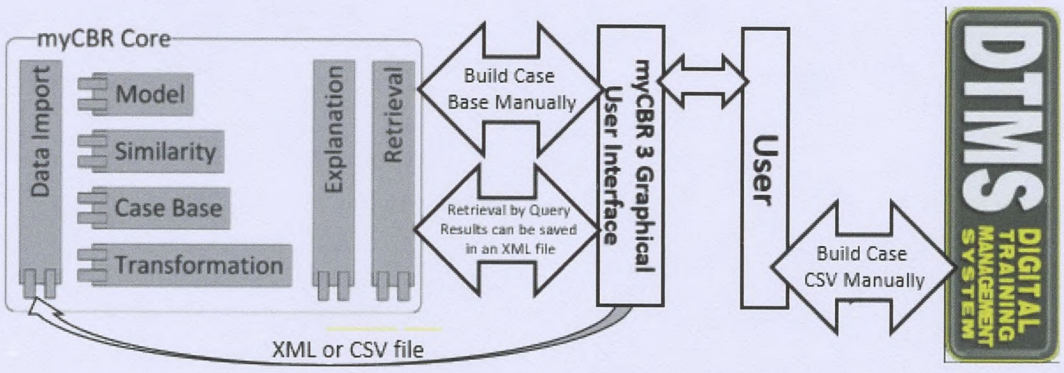


Figure 3. Intelligent Training Support System Architecture (ITPSS), adapted from [31, p.19]

3.3.1 Building the case base

The case base consists of 32 cases representing the maneuver companies from the First Cavalry Division where each company's UTP represents one case in the case base (repository). The selection of maneuver companies instead of other types of units allows for a better demonstration of ITPSS due to focusing on a larger unit base in a Divisional structure giving it more applicability (See Figure 4). Battalions highlighted in red were used to develop the case base using their company unit training plans.

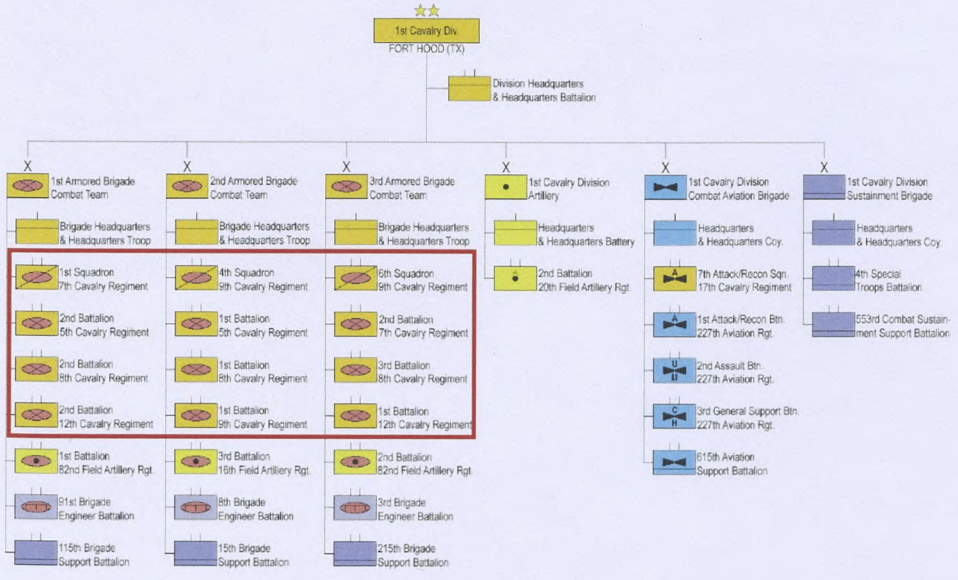


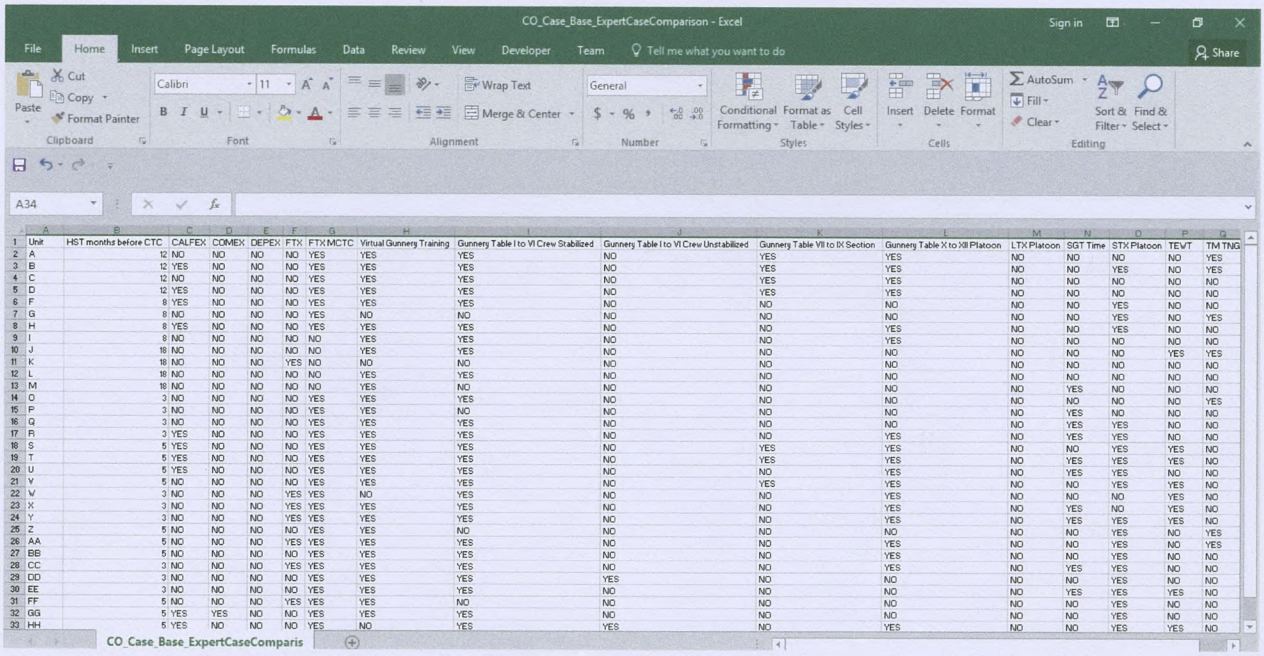
Figure 4. 1st Cavalry Division Order of Battle, adopted from [38]

Each case contains 17 attributes that were derived from the Combined Arms Training Strategy (CATS) Training Event Matrix due to the Mission Analysis Doctrinal Template being offline. Each attribute represents one training event that should be on a training calendar or unit training plan as follows:

1. Unit = the unit name listed as a letter to represent the company the case data
2. HST months before CTC = the amount of time of training plan data before a unit deployed to a combat training center (CTC)
3. CALFEX = Combined Arms Live Fire Exercise
4. COMEX = Communications Exercise
5. DEPEX = Deployment Exercise
6. FTX = Field Training Exercise
7. FTX MCTC = Field Training Exercise at the Mission Training Complex
8. Virtual Gunnery Training = virtual gunnery exercise in simulators
9. Gunnery Table I-VI, Stabilized (Crew) = live-fire gunnery exercise (tanks firing live rounds)
10. Gunnery Table I-VI, Unstabilized (Crew) = crew served weapon firing off of the track vehicle
11. Gunnery Table VII-IX (Section) = section tank gunnery exercise firing live rounds
12. Gunnery Table X-XII (Platoon) = Platoon tank gunnery exercise firing live rounds
13. LTX (Platoon) = Lite Tactical Exercise
14. SGT Time = Sergeant's Time Training
15. STX (Platoon) = Situational Training Exercise at the Platoon Level
16. TEWT = Tactical Exercise Without Troops
17. TM TNG = Team Training

Each Company should conduct each training event prior to deploying to a combat training center, but variations exist based on certification level, time available, and theater specific training requirements. Each case was converted from an excel calendar to a text file from the training event comments and then converted to a data excel file for query/vlookup to develop the overall case base that was used as the input into ITPSS (See Table 1).

Table 1. DSS Case Base used as the base input into the First and Second Studies



Unit	HST months before CTC	CALFEX	COMEX	DEPEX	FTX	FTX MCTC	Virtual Gunnery Training	Gunnery Table I to VI Crew Stabilized	Gunnery Table I to VI Crew Unstabilized	Gunnery Table VII to IX Section	Gunnery Table X to XII Platoon	LTX Platoon	SGT Time	STX Platoon	TEWT	TM TNG
A	12	NO	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	YES
B	12	YES	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	YES	NO	YES
C	12	NO	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO
D	12	YES	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO
F	9	YES	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO
G	9	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES
H	9	YES	NO	NO	NO	YES	YES	YES	NO	NO	YES	NO	NO	YES	NO	NO
I	9	NO	NO	NO	NO	NO	YES	YES	NO	NO	YES	NO	NO	NO	NO	NO
J	18	NO	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	YES	YES
K	18	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
L	18	NO	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO
M	18	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO
O	3	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES
P	3	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO
Q	3	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	YES	YES	NO	NO
R	3	YES	NO	NO	NO	YES	YES	YES	NO	NO	YES	NO	YES	YES	NO	NO
S	5	YES	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	YES	YES	NO
T	5	YES	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	YES	YES	YES	NO
U	5	YES	NO	NO	NO	YES	YES	YES	NO	NO	YES	NO	YES	YES	NO	NO
V	5	NO	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	YES	YES	YES	NO
W	3	NO	NO	NO	YES	YES	NO	YES	NO	NO	YES	NO	NO	NO	YES	NO
X	3	NO	NO	NO	YES	YES	YES	YES	NO	NO	YES	NO	YES	NO	YES	NO
Y	3	NO	NO	NO	YES	YES	YES	YES	NO	NO	YES	NO	YES	YES	YES	NO
Z	5	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	YES	NO	YES
AA	5	NO	NO	NO	YES	YES	YES	YES	NO	NO	YES	NO	NO	YES	NO	YES
BB	5	NO	NO	NO	NO	YES	YES	YES	NO	NO	YES	NO	NO	YES	NO	NO
CC	3	NO	NO	NO	YES	YES	YES	YES	NO	NO	YES	NO	YES	YES	NO	NO
DD	3	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	YES	NO	NO
EE	3	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	YES	YES	YES	NO
FF	5	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO	NO	YES	NO	NO
GG	5	YES	YES	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO
HH	5	YES	NO	NO	NO	YES	NO	YES	YES	NO	YES	NO	NO	YES	YES	NO

Figure 5. shows a screen shot for the ITPSS after the case base has been imported to it with the blue box highlighting the area the case instances should populate into and the red box highlighting the case-base statistics available.

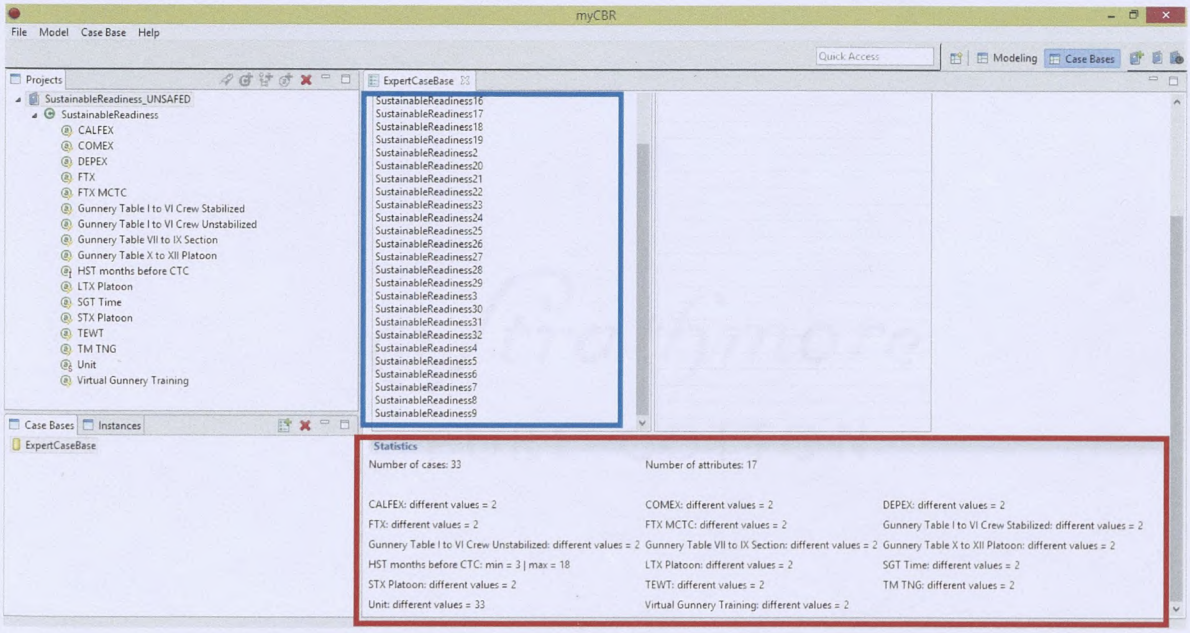


Figure 5. Case Base imported to ITPSS

3.3.2 Retrieval Algorithm

ITPSS utilizes K-Nearest Neighbor Retrieval Algorithm (KNN) built in myCBR to retrieve multiple cases. The algorithm follows the local-global approach which divides the similarity measure into a set of local similarity measures for each attribute, a set of attribute weights, and a global similarity measure for calculating the final similarity value. This means, for an attribute-value based case representation consisting of n attributes, the similarity between a query q and a case c may be calculated as follows:

$$Sim(q,c) = \sum_{i=1}^{n} \omega_i \cdot sim_i(q_i, c_i)$$

Where sim_i and w_i denote the local similarity measure and the weight of attribute i, and Sim represents the global similarity measure [39, p. 110]

3.4 System Validation

In order to validate ITPSS, one case was selected (Case A) and used to query the case base to determine if the query case would be retrieved and to what degree of similarity. The results of that query can be seen in Figure 6.

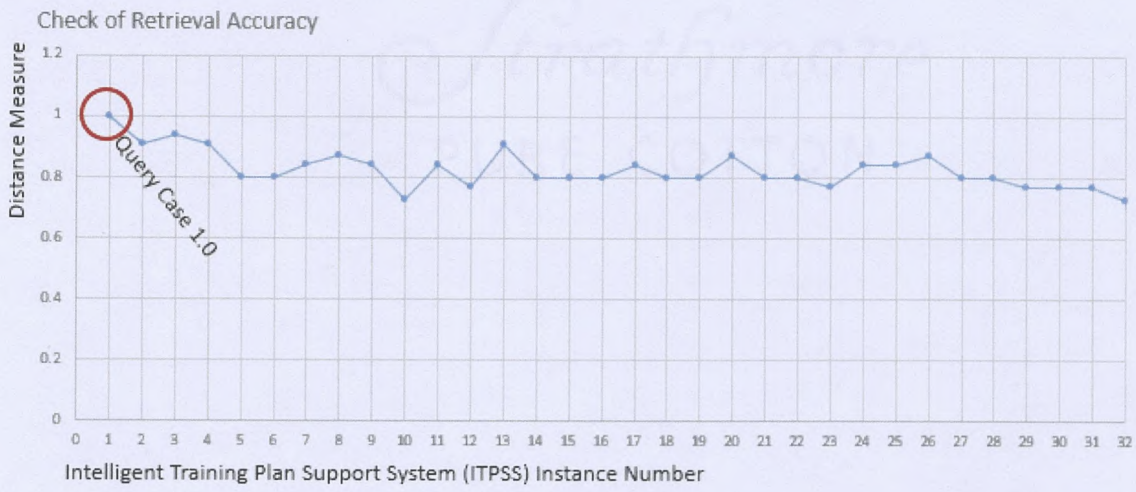


Figure 6. Check of Retrieval Accuracy

Figure 6 shows the distance measure as it relates to each instance (case) in the case base. ITPSS was verified using the check case retrieval accuracy, and check retrieval consistency tests stated in [40, p.35]. Querying ITPSS with a case always returns the query case every time the query is run which proves that the system is consistent and accurate.

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4. Empirical Evaluation

ITPSS was tested with human participants who were selected based on usage/familiarity, or having worked in positions that required the use of the U.S. Army's Digital Training Management System (DTMS) which is part of ATMS. This study aimed to determine if people who worked with DTMS would see an added value in integrating ITPSS with DTMS. Using experienced individuals who have managed DTMS in leadership positions at the Company and Battalion level provides a unique perspective into what this study is trying to accomplish by focusing on supporting the usage of DTMS at more senior levels.

Two studies were conducted to test ITPSS. The first study demonstrates how ITPSS can be used to provide similarity measure between all cases (implemented plans) in the case base to an expert case (Annual Training Guidance or CATS Doctrinal Template) that is used as the query case. The second study shows how ITPSS can help officers design their plans while being able to use other plans that are similar enough to their current plan. This way ITPSS supports information sharing where units had the capability to view other units training plans when ITPSS is integrated with DTMS. The results of the two studies were shared with the human participants who have worked with DTMS to get them to evaluate ITPSS and let us know how useful they think ITPSS is and if they would recommend integrating it with DTMS.

4.1. Research Methods

A questionnaire was designed for this study that provides an overview of the research and explains the purpose and goal of the studies (see Appendix A). The questionnaire was created in SurveyMonkey for the sake of anonymity. The questionnaire respondents were not tracked by name (anonymous). Also, no other respondent data, such as ages, names, or sex was tracked. All

participants speak English; either is active duty army officer or is retired officers or senior non-commissioned officers. All participants participated in this study willfully without any payment or coercion for their participation. The results of these questionnaires will be discussed in the following subsections.

4.2. Survey Participants

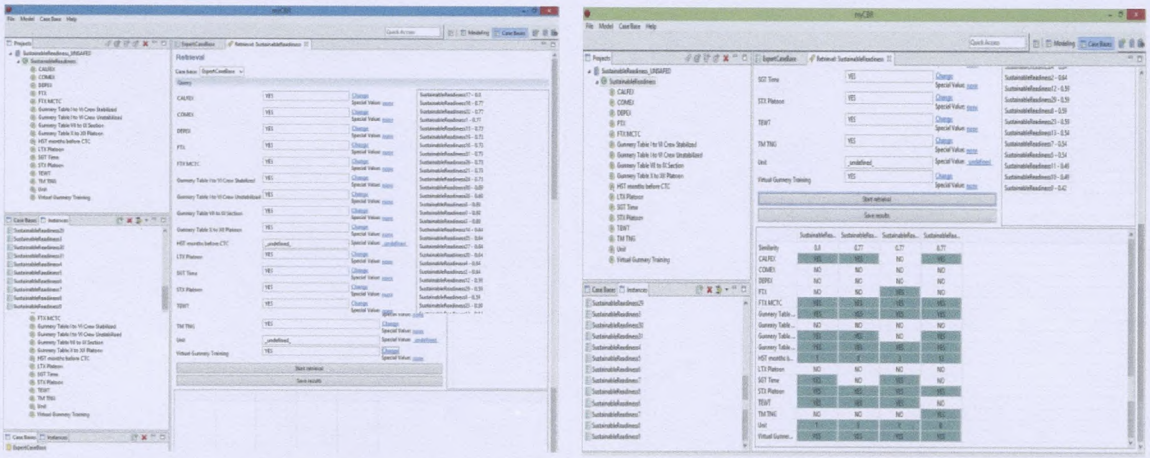
The two target audiences for the developed questionnaire are individuals who work in the Training Management Division at Fort Leavenworth, KS who manage DTMS and individuals who are current or former Battalion Operations Officers or Company Commanders who used or managed the usage of DTMS for training management. The survey was sent out to officers who I personally know have the background necessary to be included in this survey. Fifty questionnaires were sent out, and 25 have been returned. Fifty should be a reasonable size sample to allow 99% confidence level and approximately 20% confidence interval [41]. Analysis of the questionnaire results and overall questions analysis are discussed below.

4.3. First Study: Comparison of all cases to an expert case

This study focuses on how DTMS can benefit from an intelligent support system like ITPSS. ITPSS provides a degree of similarity between all the cases (training plans) to the query case (expert plan) and presents this on QTB slides. This functionality should allow commander or more specifically his staff to determine how well a unit integrated required training events into their UTP in comparison to an ATG or a doctrinal template. This should reduce man hours spent in preparing Quarterly Training Briefs and should facilitate a commander-to-commander

discussion. Most importantly, using ITPSS will allow the use of unified language instead of using different 'language' by each echelon.

For this study, the expert case used to query ITPSS is CATS TEM (see Table 3). ITPSS determines the degree of similarity for all cases in the case base to the query case and displays the four cases with the highest degree of similarity in the results section as shown in Figure 7.



(a) Expert Case (b) Top Four Retrieved Cases

Figure 7. Sample retrieved cases for the perfect plan query case

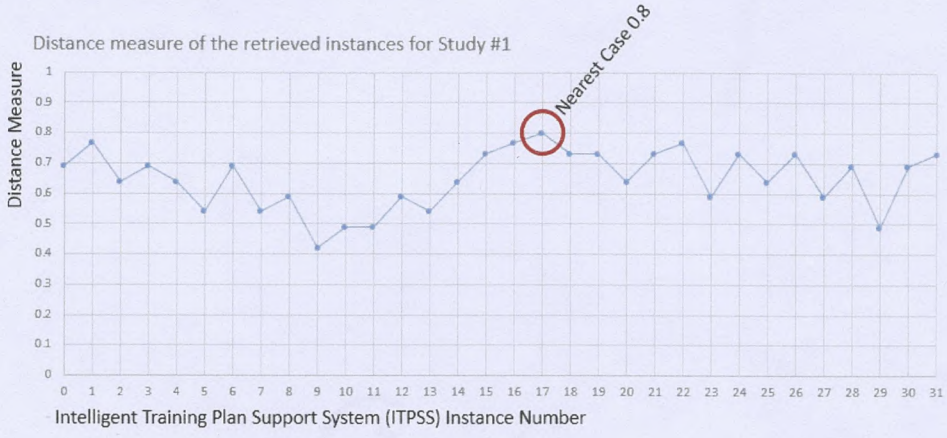


Figure 8. Distance measure for the retrieved instances for a query case

Figure 8 shows that Case 17 (Company T) is the closest case to the expert case with 80% similarity. Case 17 is considered the best-matched case due to the highest number of common features or attributes with the matching the query case. ITPSS allows the user to see the

explanation associated with Case T as shown in Figure 7(b). The explanation feature provides additional information about the different events (attributes) and values of the retrieved case.

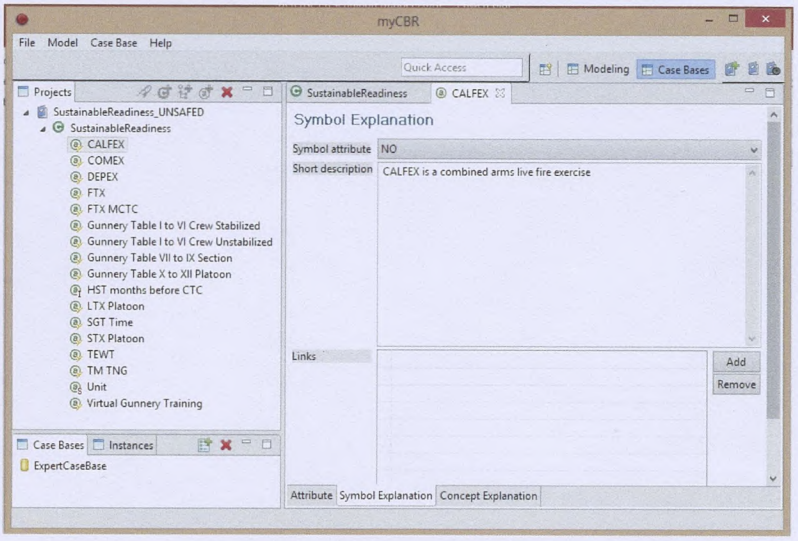
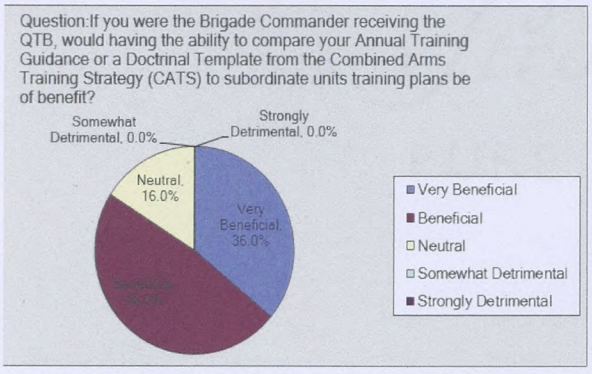
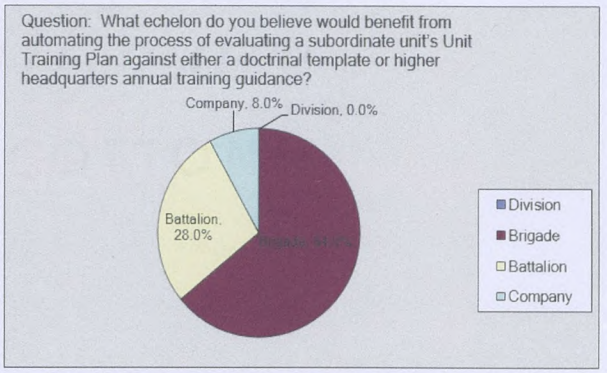


Figure 9. Explanation features in ITPSS

Human participants were mostly satisfied with the results of this study as 84% of the respondents agree or strongly agree that ITPSS would be a good addition to DTMS. 64% of the respondents believed that evaluating the implemented plans versus the expert plan would be helpful for Brigade level personnel, and over half (56%) agreed or strongly agreed with the degree of similarity of the top four returned training plans. The opinions of the human participants were captured and illustrated in Figure 10.



(a) Would the First study be helpful?



(b) Where would the First Study work best?

Figure 10. First Study Questionnaire analysis

4.4. Second Study: Training Plan Retrieval for Comparison

This study focuses on how ITPSS can aid in the development of a similar Unit's Training Plans. The second study included 32 cases divided into 27 cases left in the case base, and 5 cases used as query cases. The different attributes of the five query cases in this study (Case A, Case B, Case C, Case D and Case F) are shown below in Table 2. The retrieval results are displayed in Table 3.

Table 2. Query Cases

Unit	HST months before CTC	CALFEX	COMEX	DEPEX	FTX	FTX MCTC	Virtual Gunnery Training	Gunnery Table I-VI, Stabilized (Crew)	Gunnery Table I-VI, Unstabilized (Crew)	Gunnery Table VII-IX (Section)	Gunnery Table X-XII (Platoon)	LTX (Platoon)	SGT Time	STX (Platoon)	TEVT	TM TNG
A	12	NO	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	YES
B	12	YES	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	YES	NO	YES
C	12	NO	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO
D	12	YES	NO	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO
F	8	YES	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO

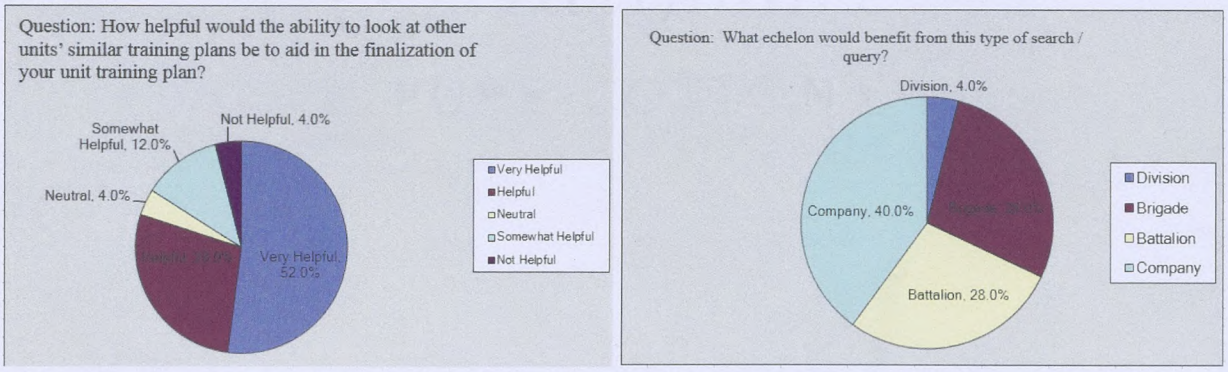
Table 3. Results Comparison Table

Study #2 Results Listing the Top 4 Similar Cases (Nearest Case / Degree of Similarity / # attributes that are the same / Number undefined attributes)				
Query #1 using Case A	O / 0.87 /4 / 2 undefined	V / 0.84 / 5 / 2 undefined	AA / 0.84 / 5 / 2 undefined	BB / 0.84 / 4 / 2 undefined
Query #2 using Case B	S / 0.87 / 7 / 2 undefined	H / 0.87 / 6 / 2 undefined	R / 0.84 / 6 / 2 undefined	V / 0.84 / 6 / 2 undefined
Query #3 using Case C	V / 0.87 / 5 / 2 undefined	BB / 0.87 / 4 / 2 undefined	I / 0.87 / 3 / 2 undefined	S / 0.84 / 5 / 2 undefined
Query #4 using Case D	S / 0.87 / 6 / 2 undefined	H / 0.87 / 5 / 2 undefined	R / 0.84 / 5 / 2 undefined	V / 0.84 / 5 / 2 undefined
Query #5 using Case F	GG / 0.91 / 5 / 2 undefined	H / 0.91 / 5 / 2 undefined	R / 0.87 / 5 / 2 undefined	U / 0.87 / 5 / 2 undefined

Table 3. shows that the top retrieved case is Case A with 87% similarity to the current plan under construction. The advantage of viewing other unit's training plans by a query process is not a current capability of DTMS. However, by allowing units to retrieve and view similar UTPs, DTMS would be sharing knowledge across formations to provide Company Commanders the ability to find units who conducted similar training cycles to view their UTPs and validate the current plan against another solution to the same problem. This allows information sharing across formations to improve Company Commander's UTP development for specific mission focused training plans (as in the case when a unit is assigned the mission of training host nation security forces in Africa, details mentioned earlier in the thesis in the introduction to Chapter 3).

Moreover, if a Commander knew which unit completed similar training cycles for similar missions, he/she would be able to contact those units to discuss lessons learned from the units returned (previous training events) for a particular query (perfect plan). A commander may also decide that a retrieved case should be adapted and used as his unit training plan. It is worth noting that adaptation is not a current capability of ITPSS.

The second study showed that 80% of the human participants either view this capability in ITPSS as helpful/very helpful if it becomes part of DTMS. 64% of the respondents agree with the similarity measure (degree of similarity) between the retrieved cases and the current plan under construction (query case) (See Appendix A).

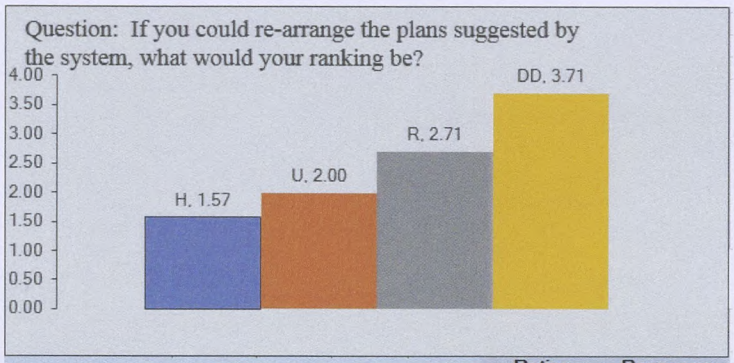


(a) Participants opinions on the usefulness of ITPSS (b) Recommendations on ITPSS usage by echelon

Figure 11. Results from human participants

Figure 11b shows that 68% of respondents believed that the ability to retrieve similar units training plans should be resident at either the Company or Battalion level (second study). Only one respondent recommended this functionality at the Division level, and this may be due to the fact that Division level campaign plans are very specific to a theatre of operations. This makes them less likely to glean from adjacent unit training plans or different campaign plans. Also, respondents would be less likely to select the Division level for this capability due to training

doctrine where headquarters only certify two levels down (Divisions train Battalions, Brigades train Companies, etc.).



Answer Options	1	2	3	4	Rating Average	Response Count
H	13	4	4	0	1.57	21
U	5	12	3	1	2.00	21
R	2	5	11	3	2.71	21
DD	1	0	3	17	3.71	21
					answered question	21
					skipped question	4

Figure 12. Second Study case retrieval ranking chart

The human participants were asked if they agree with the output provided by ITPSS in the sense of similarity measure agreement. Figure 12 shows the number of participants agrees and disagree with ITPSS's output and their suggested output. This question had the biggest variance (44%) among all the questions. The majority of the respondents disagree with the ratings from the ITPSS. A possible reason is that the plan duration was not specified in the query case, so each respondent evaluated the retrieved cases based on their operational and/or training experience). Case R had three months to train and case U had five months to train for home station training time before the unit went to a combat training center. This is reasonable, and experienced officers would have picked the instance with five months over the instance with three months.

5. **Discussion and Conclusion**

5.1 Discussion

The integration of AI techniques into future systems is already a part of planning and development guidance, and it is only a matter of time before AI techniques are implemented into many if not all Army Mission Command and home station training (HST) support systems. DTMS (Digital Training Management System) is no exception. This research proposed an ITPSS, an intelligent decision support system that can add intelligent capabilities to DTMS. ITPSS offers the ability to query a repository of training plans (case base) using case-based reasoning to either retrieve similar cases to aid the construction of a plan or to provide a degree of similarity to determine how good a training plan is compared to an expert plan. This capability would help commanders at each step of the training management process from the plan and prepare to execute and assess a unit training plan.

ITPSS is implemented outside DTMS due to some restrictions and limitations such as the researchers not having access to the code for DTMS due to DTMS being a real world, live system. Before integrating ITPSS into DTMS, three necessary requirements need to be implemented in DTMS. The first requirement is that DTMS allows units to query other units training schedules. DTMS was designed around the commander owning his or her training schedule and only through changing permissions can another unit view their unit training plan. Based on survey results, this capability should be looked at for future versions of DTMS.

The second requirement is to link other Army systems to DTMS and unify the naming conventions used to name each training event (every unit abbreviates the training event names differently) so all systems can talk to each other. And finally, the third requirement is to allow DTMS to output a CSV file that can be used as an input to ITPSS. If ITPSS cannot be integrated

directly in DTMS due to timing or Certificate of Networthiness then, at least, the technique used in this research can be implemented directly by units. Results from this research showed that expert users of DTMS (84% and 80%) indicated that the capabilities presented by the ITPSS would be a good addition to DTMS. Also, 76% of them indicated that they would be either likely or very likely recommend ITPSS be integrated with DTMS.

An additional area that could aid in the development of future versions is that Home Station Training Support systems that manage land and ranges, ammunition, and money would be linked to DTMS. Once the three requirements mentioned above are implemented and Home Station Training Support systems are linked to DTMS additional work will be needed to modify the interface of DTMS by adding tabs for the land and range system, the ammunition system, and the money system. Appendix 3 provides a recommended interface in support of this effort.

Not only does this research support future system development guidance, it demonstrates that AI integration does not have to wait for the future system to be developed, but can be added to existing systems in use today.

5.2 Conclusion

Current planning guidance for future Army system development is to leverage artificial intelligence research into future system development. ITPSS is an intelligent system that uses case-based reasoning technique to support the unit training management process, thereby improving the unit training plan development and approval phases. Integrating ITPSS with DTMS should allow DTMS to exhibit the desired intelligent behavior sooner than 2030.

The research results show the usefulness of comparing all previously implemented plans in the case base against an expert case and how the human evaluators highly recommend adding

this functionality to DTMS to provide an automated evaluation tool for commanders and staff. The results also show how the human participants highly recommend the ability to retrieve similar cases or training plans to support commanders at all echelons who are in the unit training plan development and approval process.

ITPSS uses myCBR which is open source, and that makes it a cost effective solution for the DTMS developers. Integrating ITPSS into DTMS will allow it to transform to I-DTMS that is DTMS with intelligent capabilities. Accordingly, this would improve the planning capabilities of DTMS and improve support to commanders and staff of all units in the Army.

5.3 Future Work

Future work includes adding adaptation rules to ITPSS which will help refine the solution of retrieved cases to fit the query case. Additional work needs to be done on the explanation feature in myCBR to allow the explanation feature to be part of the system output. Lastly, investigate the best way(s) to integrate ITPSS with DTMS. A recommended interface can be seen in Appendix C.

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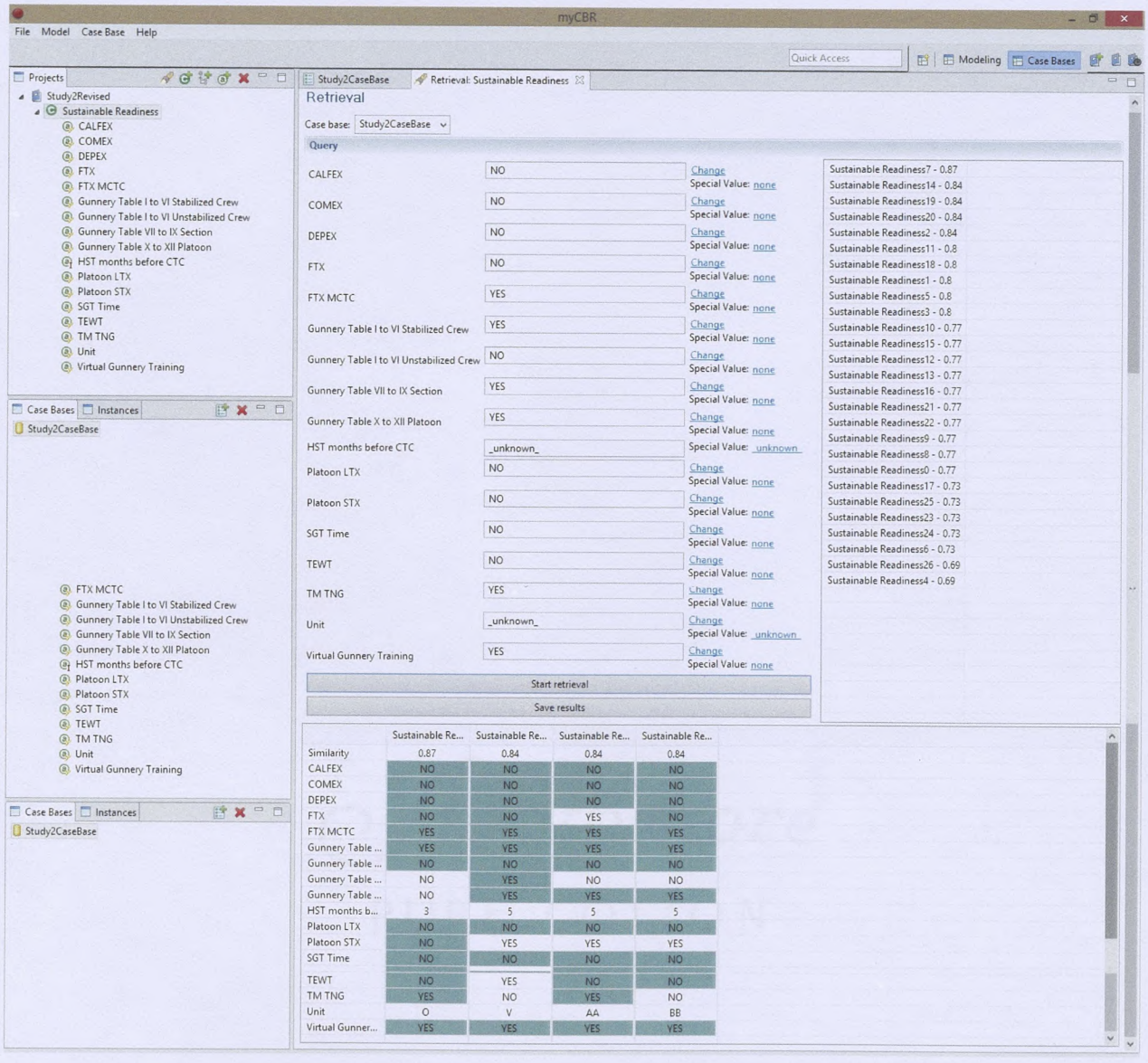
Strathmore PURE COTTON

Appendix A. Second Study Query Results

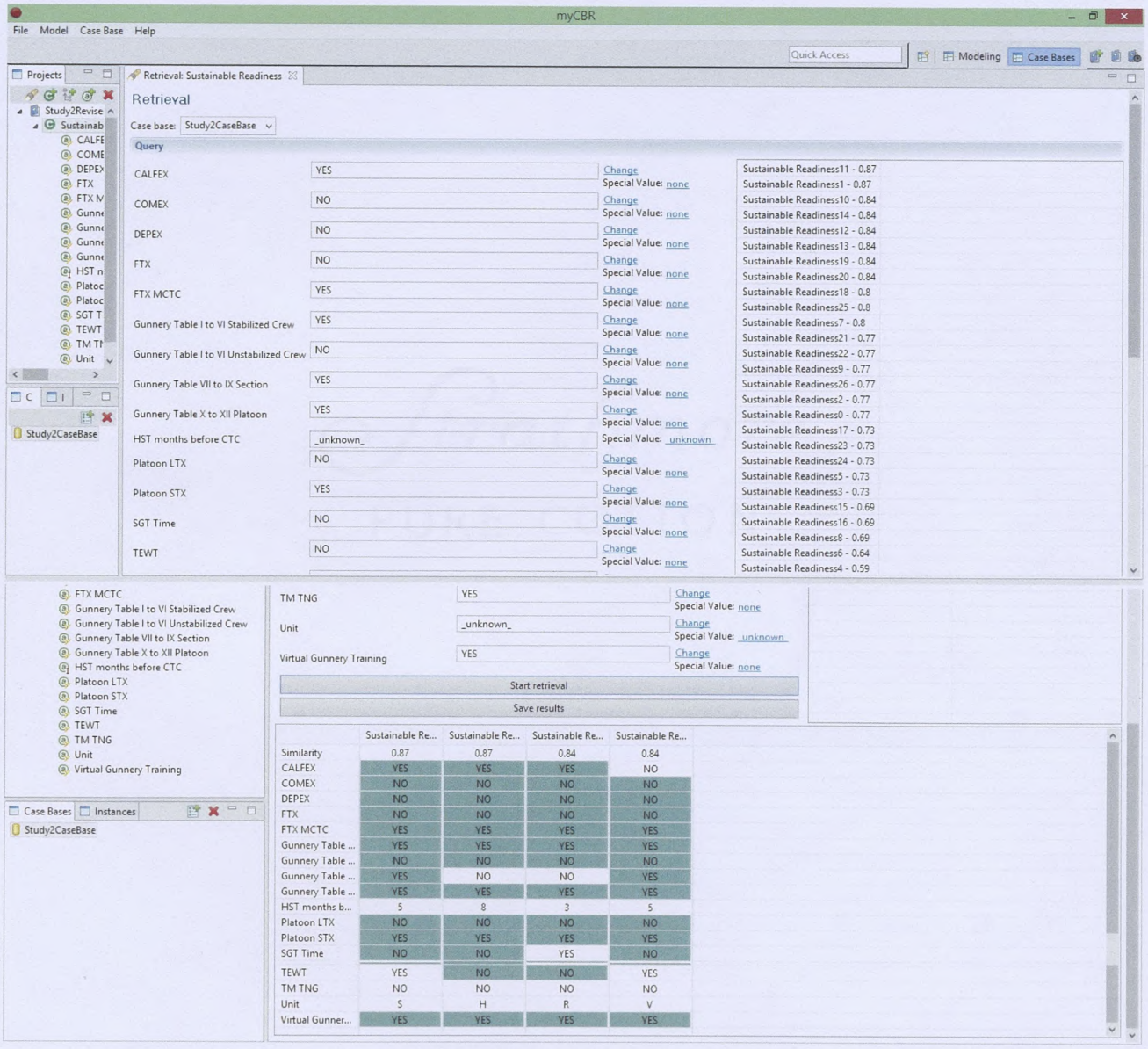
Second Study, Query #1 with Case A



Second Study, Query#1, with Case A as the query case results

Second Study, Query #2 with Case B

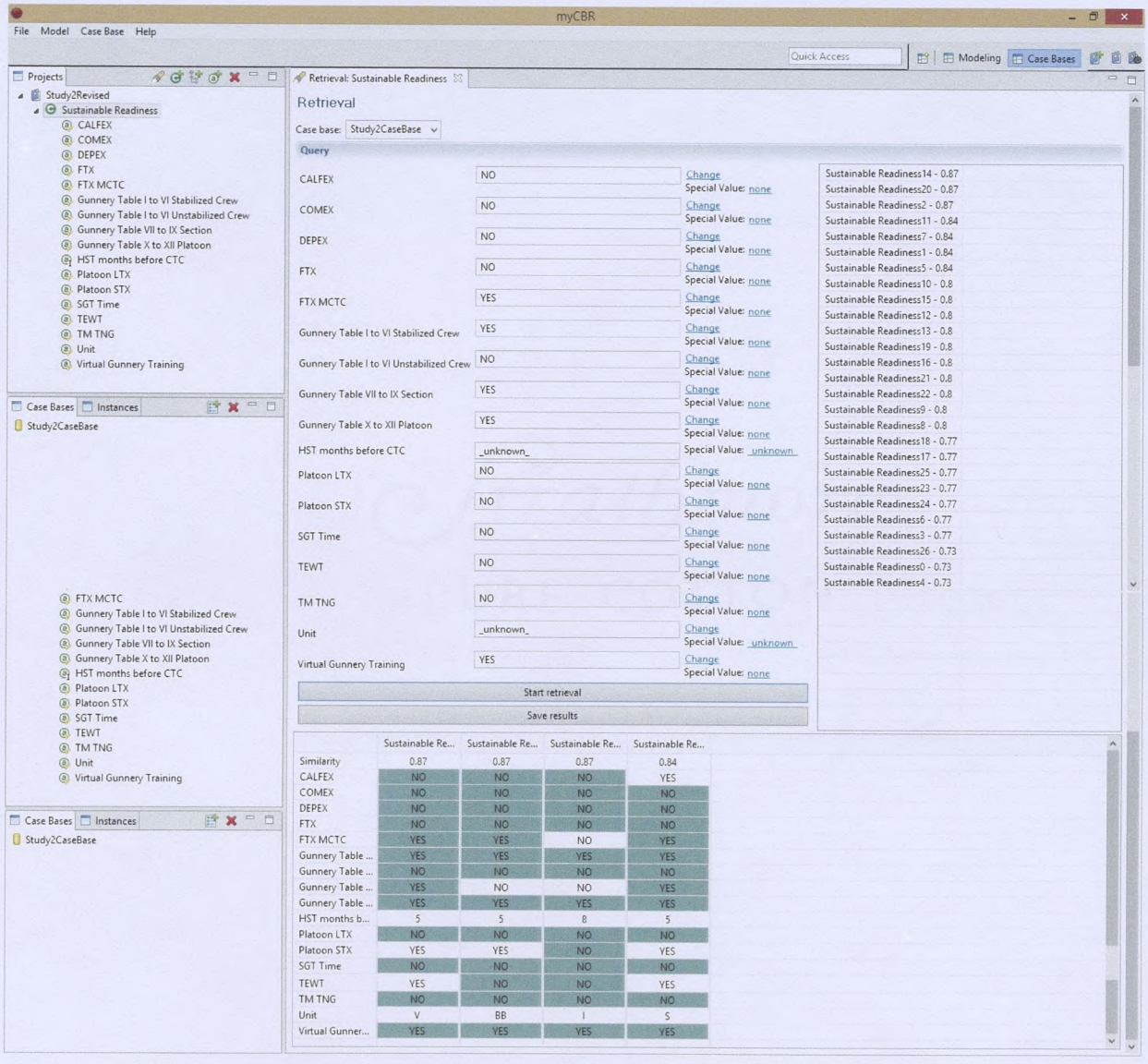
The second query was conducted with Case B's "YES" values of CALFEX, FTX MCTC, Virtual Gunnery Training, Gunnery Table I-VI, Stabilized (Crew),Gunnery Table VII-IX (Section) ,Gunnery Table X-XII (Platoon), Platoon STX, and TM TNG.



Second Study, Query#2, with Case B as the query case results

Second Study, Query #3 with Case C

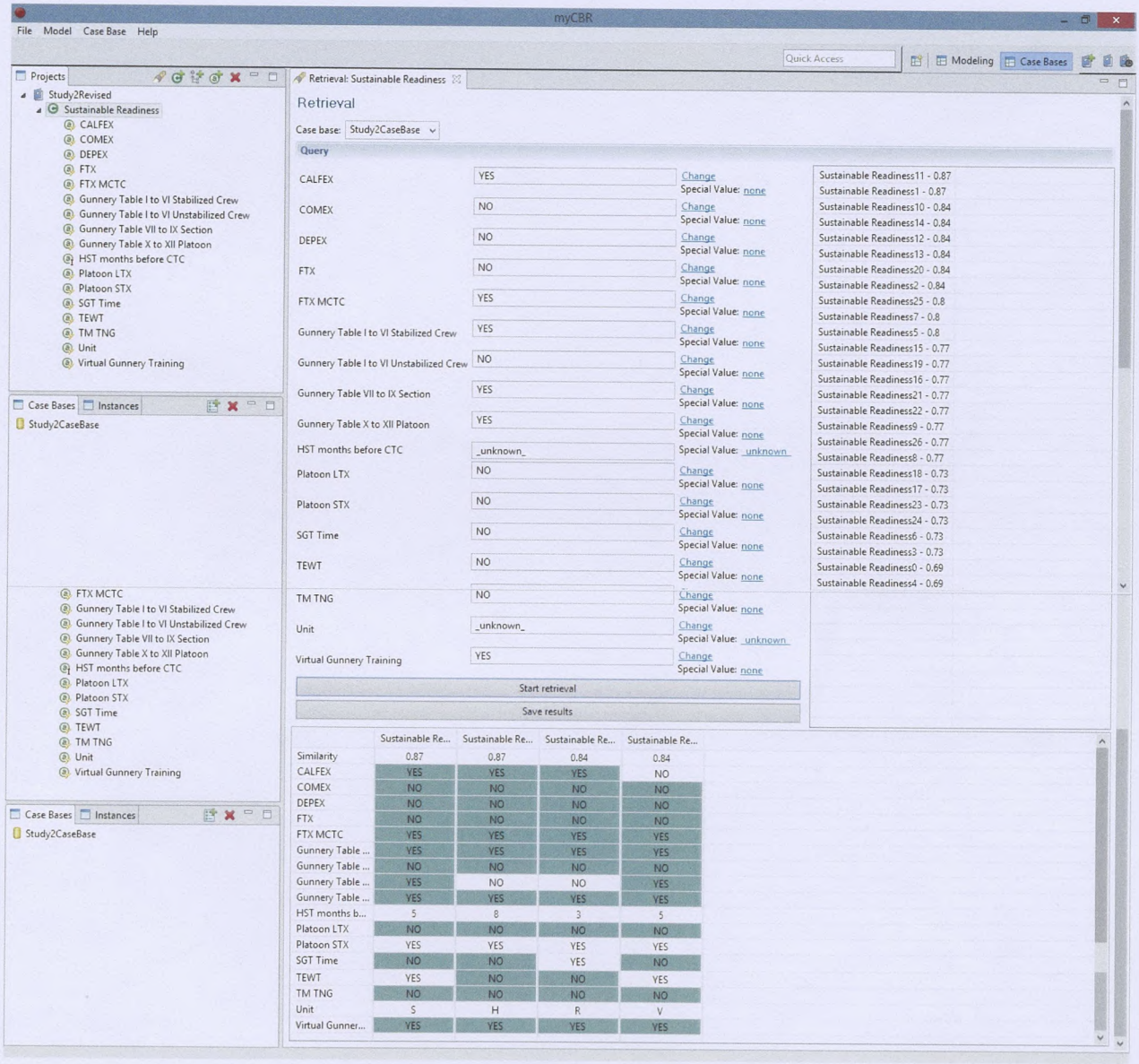
Gunnery Training, Gunnery Table I-VI, Stabilized (Crew),Gunnery Table VII-IX (Section) ,Gunnery Table X-XII (Platoon), and Platoon STX. The results of this query are below.



Screenshot of Second Study, query#3 with Case C as the query case results

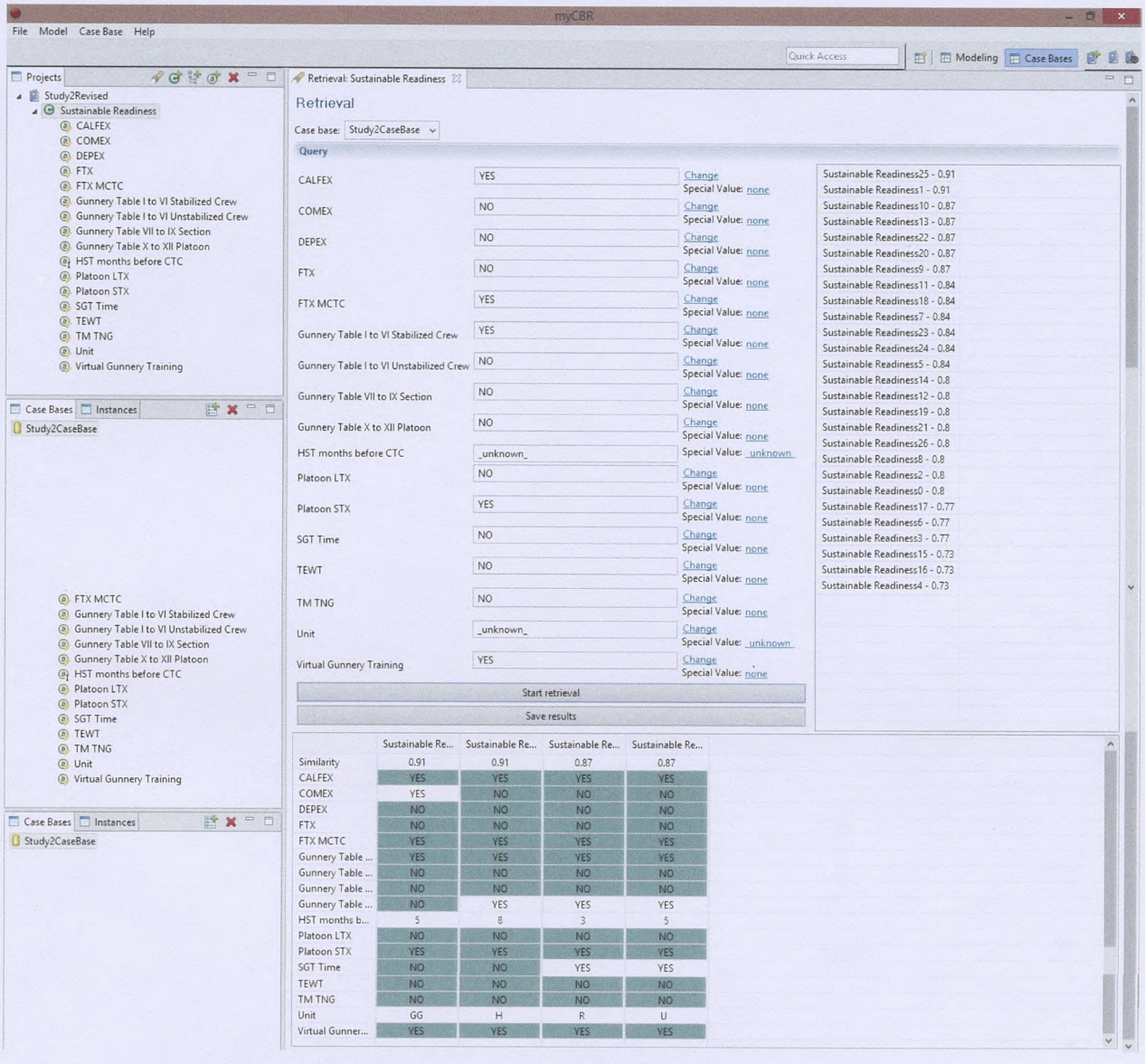
Second Study Query #4 with Case D

The fourth query was conducted with Case D's "YES" values of CALFEX, FTX MCTC, Virtual Gunnery Training, Gunnery Table I-VI, Stabilized (Crew),Gunnery Table VII-IX (Section) ,and Gunnery Table X-XII (Platoon). The results of this query are below.



Screenshot of Second Study, query#4 with Case D as the query case results

Second Study, Query #5 with Case E



Screenshot of Second Study, query#5 with Case F as the query case results

Appendix B. Decision Support System Questionnaire

Research and Thesis Questionnaire Date_____

Study explanation and goal:

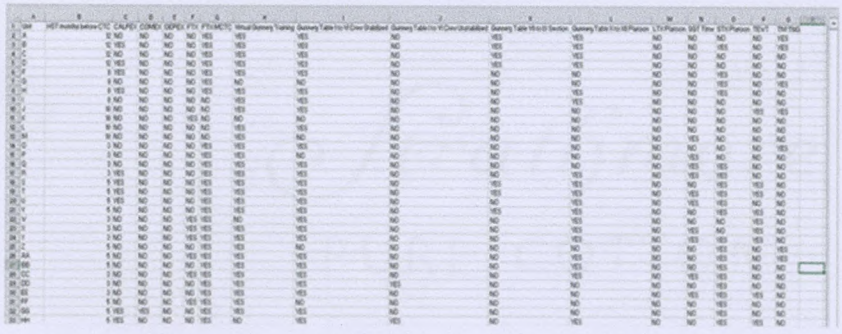
DTMS U.S. ARMY Digital Training Management System + myCBR

Please let us know what is your degree of familiarity using DTMS?

○Subject Matter Expert ○Highly Familiar ○Moderately Familiar ○Somewhat Familiar ○Unfamiliar

This research aims to develop a decision support system (DSS) that can aid decision makers in the US Army and that can be integrated with the U.S. Army Digital Training Management System (DTMS) in a way that allow DTMS to exhibit intelligent behavior. The purpose of this study is two folds: First, determine if a training guidance, either annual training guidance or doctrinal template was implemented correctly (Scenario 1). Second, determine if the system can aid/guide company commanders to refine their unit training plans after reviewing previous similar unit training plans recommended by the DSS (Scenario 2). This research presents a new way to utilize unit training plans that is not currently available in DTMS at the time of this study.

In the meantime, all maneuver companies training plans in a Division are saved in the system as an excel sheet with the plan ID or company name in the first column and all the events displayed in the rest of the columns (See below)



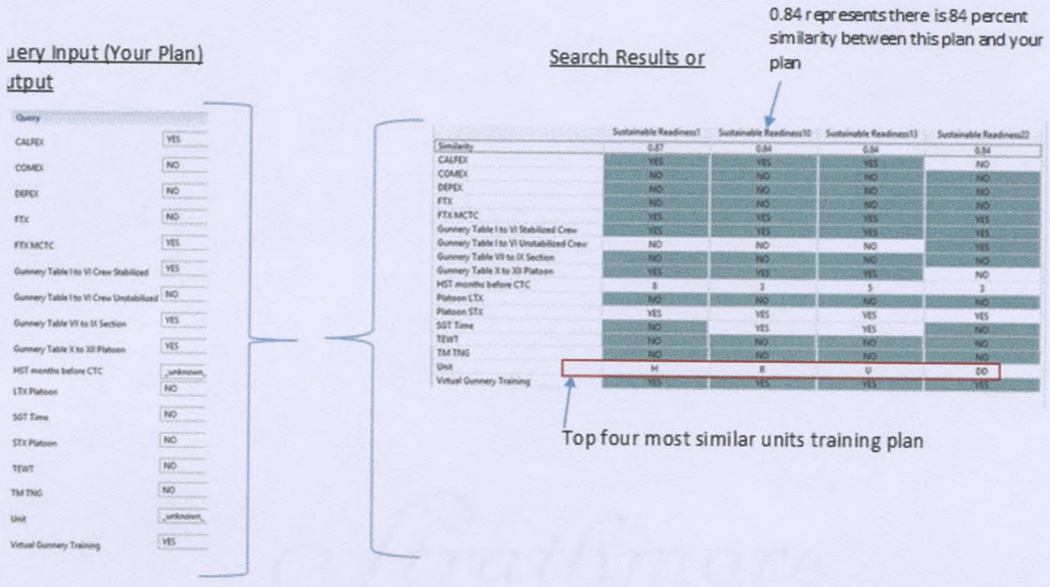
Aside note: the focus of this research is on the performance of the proposed decision support system and not on developing an interface between DTMS and the DSS.

Now please read the scenarios below carefully and answer the questions.

First Scenario:

You are an Armor Company Commander in 1st Cavalry Division and your unit has been notified they are deploying to an area in AFRICOM in twelve months. Based on this notification and training guidance from AFRICOM, you have to rewrite your unit training plan to accomplish all required training, which includes a train-up at home station and deploying to a Combat Training Center (CTC). The level of certification your Company must reach prior to the CTC is Platoon Table XII, and your Brigade Commander wants to conduct a CALFEX. In this scenario, DTMS has the

pability to allow you to view other units training plans after you feed the system with which training events you an to conduct. You can see your plan on the left side and the suggested plans by the system on the right side of the ;ure below.



Do you agree with the which plans were retrieved (87% & 84% similar), based on the training events entered into the query from your unit training plan?

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

Do you agree with the similarity of 87% for plan M and 84% for plan R as the similarity of the retrieved plans versus your query?

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

If you could re-arrange the plans suggested by the system, what would your ranking be?

1st_____ 2nd_____ 3rd_____ 4th_____

How helpful would the ability to look at other units' similar training plans be to aid in the finalization of your unit training plan?

○ Very Help ○ Helpful ○ Neutral ○ Somewhat Helpful ○ Not Helpful

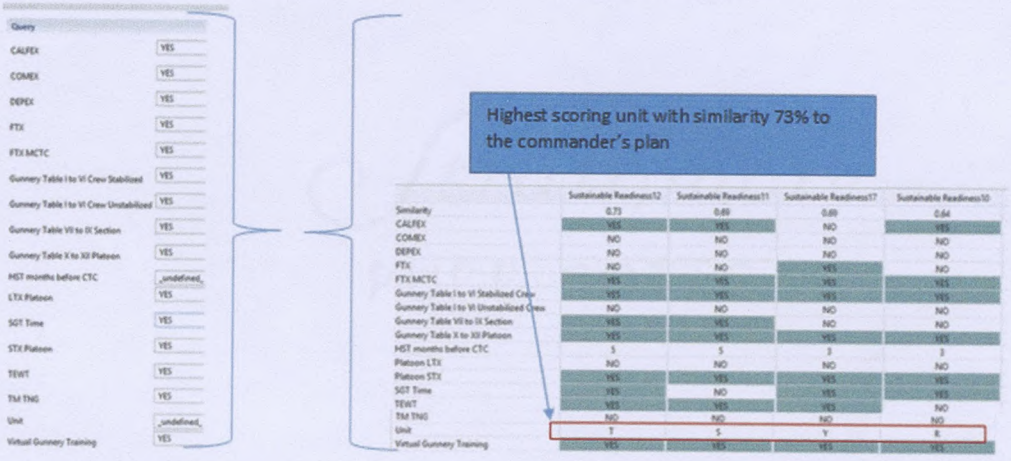
What echelon would benefit from this type of search / query?

◯Division ◯Brigade ◯Battalion ◯Company

Second Scenario:

You are Company "T"s commander, and your unit has finished updating your unit training plan. You now have an approved unit training plan for the home station train-up for the CTC rotation and later AFRICOM deployment. However, you must prepare for a QTB for your Brigade Commander who is very concerned that all required training events were planned into every unit's training plans. In this scenario, DTMS has an automated way to use the query to score how well a subordinate unit integrated training events into their unit training plans. Three of the top four scores are in your Battalion (Company R, S, and T) whose results are listed below.

Query Input (Best Case Plan from ATG)



Putting yourself in the commander's shoes, do you agree with the similarity ranking of the units in your Battalion (Company R, S, and T) based on the training events that are a part of your unit training plan that were compared to Best case or Doctrinal Training plan?

◯Strongly Agree ◯Agree ◯Neutral ◯Disagree ◯Strongly Disagree

If you were the Brigade Commander receiving the QTB, would having the ability to compare your Annual Training Guidance or a Doctrinal Template from the Combined Arms Training Strategy (CATS) to subordinate units training plans be of benefit?

◯Very Beneficial ◯Beneficial ◯Neutral ◯Somewhat Detrimental ◯Strongly Detrimental

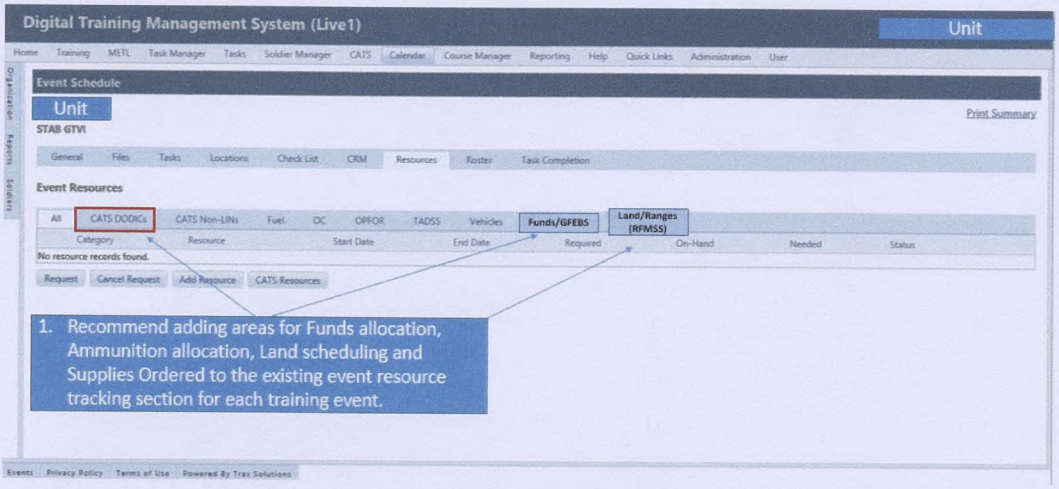
What echelon do you believe would benefit from automating the process of evaluating a subordinate unit's Unit Training Plan against either a doctrinal template or higher headquarters annual training guidance?

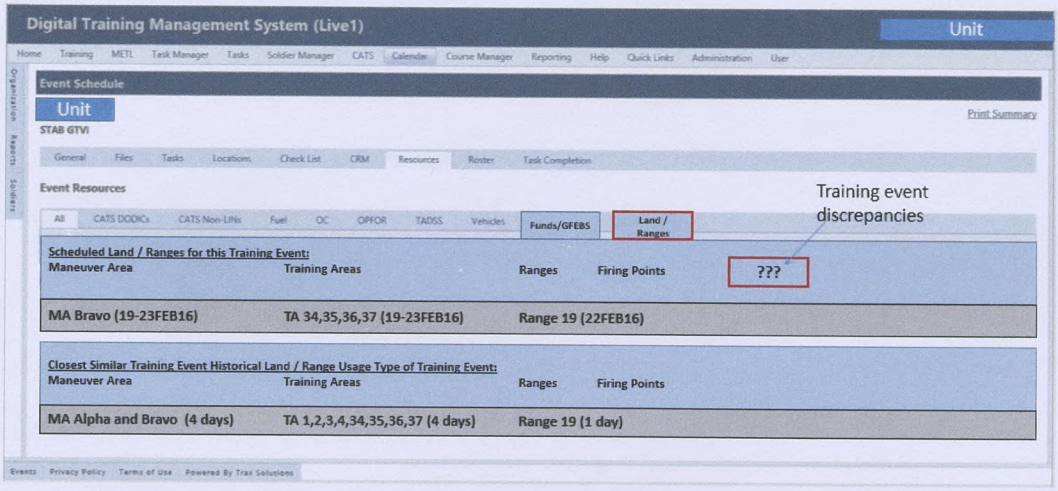
○ Division ○ Brigade ○ Battalion ○ Company

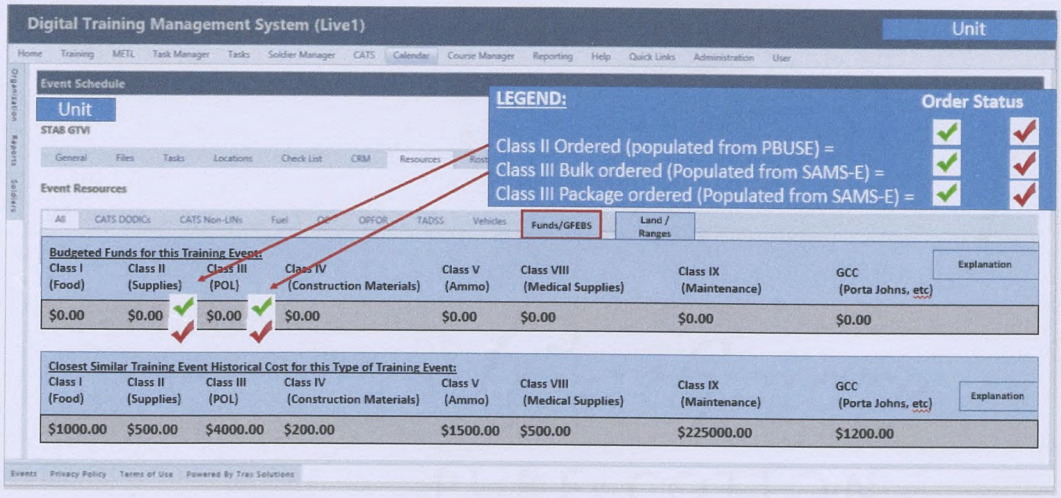
How likely would you be to recommend the proposed system to be integrated with DTMS?

○ Very Likely ○ Likely ○ Neutral ○ Somewhat Likely ○ Not Likely

Appendix C. DTMS Resource Tab Recommended Additions







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