Applying the Technology Transition Model to GSS Fielding

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Abstract

This paper outlines the efforts to introduce a proven GSS into two similar organizational contexts over a one-year period. The installations, and subsequent technology transitions took place aboard two different US Navy ships. Using the principles of action research, the project began with interventions based on the Technology Transition Model (TTM). The goal of the interventions was to engender sufficient acceptance of GSS to create a self-sustaining community of GSS users.

This research was based on an *extension on the Technology Acceptance Model (TAM)* known as t*he Technology Transition Model (TTM*). *The article provides an explanation of the TAM, the TTM and their related concepts.* Next, i*t outlines background for military decision-making in that context. It then presents background information about the development and fielding of a specific GSS. Finally, it summarizes the lessons learned in the field during the application of the TTM in two unique fielding efforts.*

1. Introduction

At the height of the Cold War, the United States military faced a known enemy that used conventional strategies and tactics. In 1989, the world situation quickly and unexpectedly shifted. The Soviet Block broke into smaller components, and its posture toward outside countries softened. Small, unknown terrorist groups, terrorist nations, and small civil wars emerged as the primary threats to international stability. At the same time, the U.S. military establishment began to broaden its role in international disaster relief efforts and more localized small intensity threats. All of these changes demanded that the U. S. military be able to respond more rapidly in less known or anticipated situations.

1.1 Technology and the American Military

New technology has often made the difference between winning and losing the battle both on land and at sea. Though technology is no substitute for leadership, intelligence or training, it can substantially stack the deck. The chariot, gunpowder, bayonet, steam engine and the atomic bomb are all dramatic examples of technologies that allowed the possessor to outclass his opponent and leave him with little recourse.

Traditionally, the U.S. armed forces have looked to technology as the "force multiplier" to win the day while minimizing risks to the army or fleet. The U.S. military is quite willing to sacrifice larger force structure in order to leverage some new technology that could be pivotal. The latest wave of technology sweeping through the war fighting community is that of Command, Control, Communications, Computers and Intelligence (C4I). Just as simple communications devices such as radios changed the very nature of the battle, the computer is expected to change all facets of the military. From the 5000-man super carrier, down to the individual infantryman, there are plans being tested and implemented to leverage computing technology to better share information, improve responsiveness and multiply the effectiveness of forces.

With the increased emphasis on high technology in the military and the ever-increasing pace of change, it had become necessary to reevaluate the accepted ideas that technologists hold with regard to the successful development and fielding of automated systems. Too many times, military organizations had been burned by technology dumping; systems were purchased and pushed out to the field with little thought for how they would be used, trained and maintained by the line units. As a result, a high percentage of technology introductions never live up to expectations. Many of the problems with fielding new technologies come from a misunderstanding of how technology is accepted into an organization.

2.0 The Technology Acceptance Model (TAM)

TAM is a causal model of actual system use, the key indicator of success for technology transition.

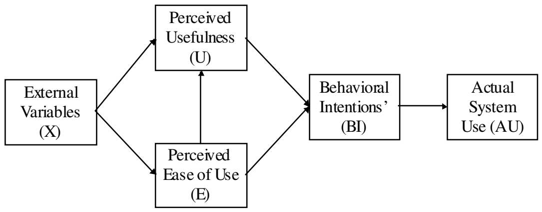

Figure 1. The Technology Acceptance Model (TAM) From Davis, 1986, 1989, 1993

Figure1 illustrates the propositions of TAM (Davis 1986; Davis 1989). It posits that actual technology use (AU) is directly caused by behavioral-intentions (BI), a measure of the strength of ones intentions to perform a specific behavior. Intention is a useful construct because it can be measured well in advance of actual use.

TAM further posits that BI will be determined by two attitudes: perceived-usefulness (U) of the technology for getting the job done and perceived ease-of-use (E), or the degree to which using the technology will be free of effort.

U and E may seem at first to be very similar, but they are quite distinct. U is the degree to which one believes that using the technology will lead to improved job performance: *"Will I do my job faster? Will my boss be happier with my results?"* On the other hand, E is the degree one believes the technology will leave ones mind free to work. *"Will I remember how these menus work? Will I have to fight with the network?"*

TAM proposes that a myriad of external variables (X) like system-design-characteristics and self-efficacy may combine to change one's perception of usefulness and ease-of-use. The model also posits that an increase in E should cause an increase in U. The unspoken assumption underlying this proposition may be that cognitive resources are limited, therefore the cognitive load imposed by the tool will interfere with task performance. If the tool is easy to use, it will be more useful for the task than if it is hard to use. TAM does not explore the mechanisms by which X may affect U and E. The model may summarized:

$$AU \cong f(BI) \cong f(U, E, X)$$

While working with the Navy's Third Fleet, we followed the precepts of action research. We began with a theory, TAM, which guided intensions to influence the perceptions of ease-of-use and usefulness among the staff. During the course of our work, a new, somewhat richer model emerged (Briggs 1999). The result is the Technology Transition Model (TTM). While TTM springs from TAM, it does not replace it. TAM predicts and explains a state-of-mind achieved after a one-hour exposure to technology; TTM attempts to explain what causes a group of technology users to become self-sustaining.

The next section argues the propositions of TTM. A description of the critical incidents that gave rise to the model appears in a later section.

3.0 The Technology Transition Model

Figure 2 illustrates the fundamental propositions of TTM.

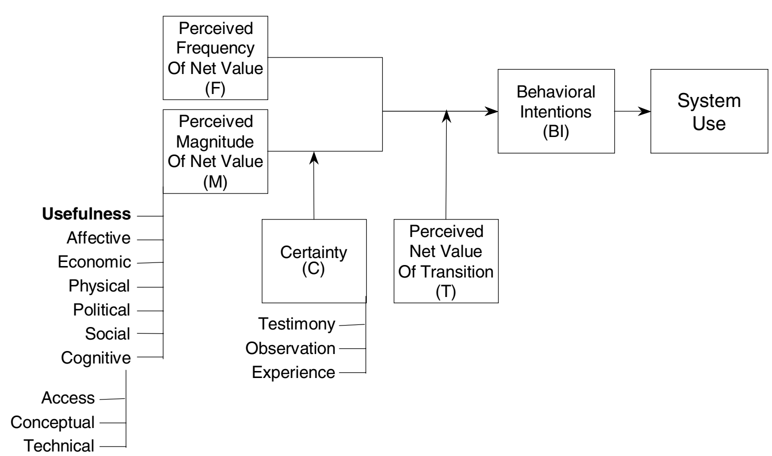

Figure 2. The Technology Transition Mode

Like TAM, TTM posits that actual system use is a function of Behavioral Intentions (BI). However, it posits that BI will be a multiplicative function of perceived-magnitude -of-net-value and perceived-frequency--of-net-value.

3.1 Perceived-Magnitude-of-Net-Value

We define perceived-magnitude-of-net-value (M) as an attitude, a subjective assessment of the probable consequences of changing from existing technology to the proposed technology. Note that M is not a measure of how big the differences will be, but of how the prospective user feels about those differences. Upon being exposed to the technology, prospective users will synthesize a holistic sense of how their lives will be different if they change to the new technology. That perceived difference will evoke an affective judgment, for example, *"overall, this will be good for me",* or perhaps, *"life is going to get a lot worse."* That response will have some magnitude - large or small, and it will have some valence or direction - positive or negative.

3.2 Dimensions of Net-Value

There may be a number of dimensions for perceived-magnitude-of-net-value. Davis (Davis 1986; Davis 1989; Davis 1993) identifies a most prominent instance of perceived-value as usefulness, the degree to which the user believes the technology will enhance job performance. If the user thinks the new tool will greatly improve job performance, this might be an instance of a positive perceived-value. However, there are other dimensions of perceived-value such as: affective, economic, physical, political, social and cognitive.

Prospective users may synthesize a variety of competing values of different magnitudes and directions into an overall assessment (Robey 1979; Nickerson 1981). For example, the users might believe that a new technology would substantially improve organizational profitability (large positive economic value) but that it might cause the users to lose a modicum of influence with managers (small negative political value). They might find the new system somewhat more awkward (small negative cognitive value) and therefore a lot more frustrating (big negative affective value) than the present system. However, it might be that the new technology provides a forum for more frequent exchanges of ideas among friends (modest positive social value). In the end, the prospective users generate an overall net assessment of how much they will like or dislike the changes engendered by the new system. We call this final assessment the perceived-magnitude-of-net-value of the change (M). M may be positive or negative.

M pertains to a comparison of the existing system to the proposed system. It is a net assessment, not an absolute assessment. For example, the old system might be terribly difficult to use, a negative cognitive value. The new system might also be hard to use, also a negative cognitive value in absolute terms, but if it does not seem as hard to use as the old system, the result may be perceived as a net positive cognitive value.

We have identified at least three dimensions of cognitive value: technical, access, and conceptual. Technical value derives from changes in the difficulty of manipulating the technology. Access value derives from changes in the cognitive load of gaining access to and permission to use the technology - the so-called "hassle-factor". Conceptual value derives from changes in the cognitive load of understanding what the tool is supposed to do for the user.

TTM posits that any number of factors external to the individual may be perceived as creating positive or negative value along one or more dimension in one or more directions simultaneously. Thus, in TTM the dimensions of value subsume and explain the effects of the external factors, so there is no separate construct in the model to represent them.

3.3 Perceived-Frequency-of-Net-Value

Users also consider how frequently (F) they expect to derive the net-value they perceive. Will they derive value moment-to-moment? Daily? Twice a year? TTM posits that F and M combine multiplicatively to cause B. F may be zero or positive, it cannot have a negative value because there is no frequency less than zero occurrences per time unit.

No matter how high M becomes, if F is zero, BI will be zero. Likewise, no matter how high F becomes, if M is zero, BI will be zero. A small positive perceived-net-value obtained frequently may lead to a positive BI. Likewise a large positive M and a low F may lead to a positive BI. If M becomes negative, BI may also become negative, and the user may actively avoid system use.

Thus, the relationship between F, M, and BI may be expressed:

$$BI \cong f(F * M)$$

Among other things, this model suggests that a frequent minor irritation, such as, having to reset a server twice a day, may be sufficient to outweigh larger, but less-frequent benefits.

3.4 Perceived-Net-Value-of-Transition

But what of a technology that engenders a small positive M and a low F? Will it be accepted? That may depend on perceptions of switching costs and benefits. TTM posits that users also attend to the perceived-net-value-of-transition (T) when choosing whether to accept a new technology. While F and M relate to a comparison of the existing system to the proposed system, T represents the value derived from the transition activity itself, apart from the value the new system will deliver. T represents a valanced synthesis of affective responses to switching-costs and switching-benefits. For example, the learning curve for the new system would represent a negative cognitive value. On the other hand, a trip to San Francisco for training classes might be perceived as having positive economic, affective and social values. Being regarded by one's boss as the project champion for new technology might offer positive political and social values, while having to shepherd the multitude of technical difficulties of establishing the new system might be a negative cognitive value. In the end, the prospective user will synthesize the perceived values associated with effecting the change into a subjective judgment of the net-value-of-transition (T). They will weigh T against the value of (F * M). If T is larger, the user may elect not to use the system. Thus a low F, low M system may not be accepted unless T is also very low. The future benefits must outweigh the switching costs. Thus, the relationship between F, M, and BI will be moderated by T:

$$BI \cong f(F * M - T)$$

3.5 Certainty

People develop their attitudes toward a new technology based on their exposure to it. We identified three kinds of exposure: testimony, observation, and experience. Testimony may be as informal as a conversation at a water cooler or as formal as a refereed academic article. Observation may range from a glimpse of a video clip to several days of watching over people's shoulders as they use the technology. Experience may range from a few minutes of hands-on playing to days of intensive use for mission-critical applications.

Whatever the form of exposure, the prospective user will use it to form some assessment not only the magnitude of the perceived-net-value, but also some degree of certainty (C) about that assessment. Certainty is a subjective probability that an expected net-value will actually be obtained. Certainty may take on a value from 0.0 to 1.0.
Certainty acts as a multiplicative moderator on M with respect to BI, thus:

$$BI \cong f(((M * C) * F)) - T)$$

Which may be rewritten:

$$BI \cong f(MCF - T)$$

Like TAM, TTM posits that Actual Use (AU) is a function of Behavioral Intention (BI), thus the complete model would read

$$AU \cong f(BI) \cong f(MCF - T)$$

Having laid out the arguments of TTM, this article will now turn to exploring the derivation of the model. The next section presents the context of the technology introductions and the specifics of the systems involved.

4.0 Gaining Advantage in Decision Action Cycles

In a conflict situation, a general pattern emerges for the command and control of forces. Commanders try to understand the situation and anticipate potential enemy actions. In effect, this is a kind of theory building about the situational picture. Then they try to take action to expand their own options and to limit those of their opponent. By doing so, the commander hopes to control the conditions and continue to force his will on the enemy until victory is attained. Most people instinctively recognize this sequence, but as with most decision theory the iterative nature is largely ignored. People generally view decisions and their accompanying situations as though they are discrete. In an adversarial conflict, nothing could be further from the truth. Each decision and action builds on the last.

By studying air combat actions in Korea, U.S. Air Force Colonel John Boyd was able to distill some lessons about decision cycles and competition. He found that in competitive asynchronous engagements a faster decision cycle is an inherent advantage. Briefly stated, his theory is that before one can take an action against an enemy one must first observe the situation, create a mental model and then decide on an option based on the mental model. By interfering with this decision cycle, one can impede the opponent and cause paralysis and ineffective counteractions.

Each time an opponent acts, he has the ability to disrupt his enemy's decision-action cycle. Thus, whoever can act first has an advantage because he is changing the situation. This causes the opponent to either act inappropriately or to restart the decision cycle. This is often referred to as "getting inside" of the enemy's decision cycle (Boyd 1987).

Boyd then found that he could generalize this process to a much larger scale. When viewed in terms of this approach, one can easily find many historical situations where this has been true. In the early stages of WWII, for instance, the French had a large well-equipped standing army. In spite of this, it quickly dissolved in the face of the fast-paced German blitzkrieg. The French were not defeated because they were outfought on an individual level. Their defense disintegrated because the Germans were operating at a pace they were totally unprepared to match.

Obviously, the advantages of a compressed decision-action cycle are not realized in the single masterstroke. One can really only expect to maintain a competitive advantage through repeatedly forcing the enemy back on his heels and wresting control of the situation from him.

Applying this methodology can provide a real advantage, provided the opponent does not disengage or purposefully slow down the battle. Commonly, the application of this theory is referred to as speeding up the operational tempo (OPTEMPO).

5.0 Experiences

Traditionally, the Center for the Management of Information (CMI) has been involved mostly with collaborative meetings and electronic meeting software (EMS). During a visit to one of the collaborative spaces onboard the USS Coronado (AGF-11), the Third Fleet chief of intelligence proposed the use of an EMS to support an ongoing twenty-four hour per day meeting for his staff. A test application GSS was approved and implemented soon after.

Up to that point, the intelligence staff was separated throughout the ship as is illustrated in Figure 3.

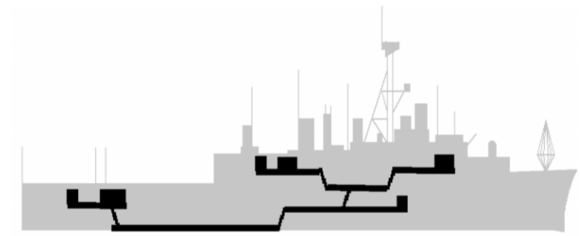

Figure 3. Intel Spaces

The intelligence staff was primarily made up of cryptologists, analysts and watch officers. The cryptologists would receive information from a variety of sources. When they saw something noteworthy, they would record it in their paper-based logs. The analysts, in turn, would communicate with the cryptologists and read their logs to try to find information that might provide a greater understanding of the situation. For instance, an analyst might conclude from increased activity on a satellite photo that a submarine was about to put to sea. The analysts would record their findings in their own logbooks.

The watch officers would then circulate among the analysts trying to tie together higher levels of information into a synthesized situational picture of the opposition. For example, the watch officer might conclude from the new submarine going to sea and increased mining activity that the opponent was going to attempt to blockade a port.

With intelligence staff spread throughout the ship, the watch officers found it difficult to maintain situational awareness. It could easily take a watch officer up to half an hour to communicate with all of the analysts to develop his/her greater situational picture. The use of the GSS allowed the entire intelligence staff the ability to immediately enter items of interest in the collaborative log. These data would then be immediately propagated throughout the computers of the other staff members.

The analysts would have immediate access to the cryptologists' entries. This allowed them to quickly scan for important items that might have greater meaning. They could then post their analyses on-line for the whole community. The watch officers, in turn, would synthesize the data more quickly into knowledge that the commander could use. Even though the software used was just a general purpose EMS application, this software gave the staff the ability to perform in way that was previously impossible. The intelligence section built their processes around the GSS.

5.1 Collaborative Logs

With the success of the intelligence logs, CMI and the staff then moved to expand the collaboration to other areas. The first of these new applications of the technology was in support of the Battle Watch Captain (BWC). The BWC is the supervisor of a watch pulled by representatives of all of the functional communities in the command (ground, air, undersea warfare, intelligence, weather and oceanographics and C4I). These representatives all support the Battle Watch Captain as he/she supervises the forces and the battle. It is the BWC's job to monitor the pulse of operations so that he/she can brief or alert the commander as to the current situation.

The BWC operates out of the Joint Operations Center (JOC) that serves as the nerve center for the joint task force. The requirements for the BWC log were quite different than for the Intel log. It required less analysis, but a wider audience would share the data. In fact, the BWC log is on the computers of the Admiral, his chief of staff, and all of the top-level leaders in Third Fleet. Users consistently agree that the BWC log allows them to quickly and efficiently update their situational awareness without interrupting the watch. Additionally, they have noted gains from having a wider group of people aware of the potential problems and opportunities facing the fleet. In this way, the collaborative logs application directly supports a compressed orient phase that also provides a more accurate collective model.

We have also found that the collaborative log helps to set and reinforce standards for what is considered salient information by the staff. On several occasions, we have noted situations where log users would correct other users for making inappropriate entries. These corrections were taken to address a perceived straying from topic or an inappropriate level of detail. This facet of the application may tend to assist in building the collective mind of the group.

To differentiate the collaborative logs and give users a common name, we started to call them Command-Net. Otherwise, CMI tended to take a hands-off policy towards the use of the application. We found ourselves frequently responding to requests for ad hoc logs that would be used and then shut down at the completion of the exercise. During one exercise in 1998, there were five logs running simultaneously.

CMI researchers instructed users how to operate the application, but let the community decide how it would be utilized. As a result, each collaborative log implementation has taken on a personality all its own. While the Intel log is used for analysis, the BWC is more of a traditional log and the Coalition Exercise Control Group (CECG) log was used as a planning tool for coordinating the war game.

However, some trends are immediately obvious for all logs. The amount of traffic is directly proportional to the amount of action in the exercise. During periods of intense play, such as prior to an amphibious landing, the log activities would peak. It should be noted that the log activity would quickly drop off after the users reached a threshold point where they were too busy to make log entries. In the JOC, the solution was to task an assistant BWC with actually making the log entries.

Additionally, we have found that the flavor of an ad hoc log will be directly influenced by the experiences of the early users of that log. For example, during two different exercises the Joint Air Operations Control (JAOC) log was used. In one situation the first watch officer was inexperienced with logs in general. He set the tone for the log by making a few very terse entries. This pattern carried through for the remainder of the exercise. During another exercise, an officer who had extensively used the BWC log initiated the JAOC log. As a result, it began to mirror the Battle Watch log.

5.2 Expanded Collaborative Log Usage

In the spring of 1999, CMI was asked to install the collaborative logs on an aircraft carrier that would soon be deploying with another fleet. The use of the collaborative logs on board the aircraft carrier USS Constellation (CV-64) was a direct outgrowth of its use on the USS Coronado. An aviator, the admiral in charge of the Constellation's task force had used the collaborative logs on board the Coronado while he was acting as the Joint Forces Air Component Commander (JFACC) during an exercise in the previous year. He had noted the usefulness of the system and had requested that it be installed. The destroyer squadron commander in the task force had been the operations officer for Third Fleet. As such, he had extensive experience with the logs and with the CMI researchers embarked on the Coronado. He directed the admiral's staff to make inquiries about an installation from the CMI research team.

Upon contact, a CMI researcher flew out the next day to get underway with the ship. Over the next twenty-four hours, he set up the log with a new set of users, trained the sailors that would be administering the system and put together an extensive users' guide. This was a period of great activity on the Constellation. The ship was performing an intense training and evaluation program for all combat systems, known within the Navy as 'work-ups'. Work-ups are done to certify the ship and its systems prior to a major deployment. The Constellation's task force was scheduled to deploy to the Middle East in a months time.

At one point, the researcher made an appointment to train users. When he arrived for the appointment, he found they had already been using the log application for several hours. They had opened the system and started using it on their own. Generally, we found this to be representative of the level of training required for users of the system. Most log keepers are concerned with basic functionality of the system. They want to be able to make entries and read them. This level of user training can be accomplished with little or no outside intervention.

The success of this use of the collaborative logs led to the installation on the USS Chosin, a guided missile cruiser in the same command. The change agent in this case was a junior officer who had been exposed to the logs onboard the Constellation. He sold the application to his captain, who then asked him to pursue it further. The captain of the Chosin clearly saw advantages to leveraging technology within his command. He was an early adopter who was unique in that he used his own discretionary funds to further automate his ship beyond the baseline that the navy provided. Additionally, he reassigned his crew to support the greater level of computer support.

CMI dispatched a researcher to Hawaii to ride the USS Chosin and perform the training and installation functions much as had been done on the Constellation. The researcher was on board for two days. Although the captain was providing support and emphasis, the process did not go smoothly. The crew was stretched thin and the appropriate administrators were not available for training. Instead of training a computer support professional to perform the administration duties, the researcher was put in contact with an operational specialist who did not have extensive knowledge of automated systems. He did, however, train the junior officer who had been the change agent. Unfortunately, this officer was a liaison to the Constellation and would not actually be onboard the Chosin during operational periods.

Not surprisingly, in the case of the Chosin, the initial training and installation was not successful. The first installation was unsuccessful because the operational specialist selected to act as the administrator was not able to perform the duties with the training he had received and he was not comfortable working with the guide. When the system experienced a technical problem, no one on the ship was prepared to act. The research team had to take a second trip to the ship.

During the second installation, a different researcher rode the Chosin for five days. During this time, he was able to adequately train a computer specialist to act as the administrator and he was able to work directly with the officer in charge of computer systems aboard the ship. Both of these individuals were trained to operate the system and would be on the ship for the duration of the deployment. The researcher also spent time training the watch standers in the use of the system. Additionally, he gave a presentation to the assembled officers in the ship's wardroom on the use of the system.

The second installation was hindered, nonetheless, by the unwillingness of the computer systems officer to actually start utilizing the logs while the researcher was on site. He felt that the watch standers were too busy with work-ups to start training on a new system. In spite of this, the crew was fully trained and equipped to use the application.

By the initiation of the deployment, the Constellation was using the logs extensively. The admiral's staff was using it in his Task Force Command Center (TFCC). The carrier's commanders and staff officers were tied in to the logs and could update their situational awareness at any time. On the Chosin, the computer systems officer had set up a log and was populating it with some items that he thought would be of value. The watch standers had not actually begun to use the log.

5.3 Mid-deployment Visit

The two CMI researchers took an opportunity to meet with the task force in the Persian Gulf several months later. In October 1999, they flew out to the task force and rode each ship for several days. During this period, the team was primarily interested in evaluating the usage of the system. This evaluation was three fold. First, they wanted to see how users from the admiral on down were using the system and the information it provided. Second, they were trying to distill lessons about the features and attributes of the application itself that would then be used to drive development of new versions. Finally, they were interested in learning about how the system and the users were involved in the different staffing and decision-making processes.

The research team found that the usage on the Constellation had expanded in scope and in breadth. The ship still ran the TFCC log and it retained its basic attributes. There were, however, more groups integrated into its use. Most notably, the destroyer squadron dovetailed their watch log into that of the TFCC. This was important because for the first time a command's log was subsumed into that of that of another. It provided a completely new level of coordination that the researchers had not seen. Previously, the closest level of coordination between logs occurred when users would read multiple logs to gain their operational perspective. Additionally, another log was started by the intelligence community on the top secret LAN. The researchers were not able to study this group due to the sensitive nature of their operations.

Among the watch standers we interviewed, the most surprising thing was some resistance to initial use. Though watch keepers found it simple to use, they resisted because of a fear of micromanagement. A significant number of people stated that they were hesitant to use the system because they were afraid that they could not be candid in their entries or that the chain of command would use the transparency of the process to centralize decisions, seize authority and meddle in operations. This, however, never materialized and even the skeptics were won over by the system's positive attributes.

When the researchers left the Constellation, there were plans afoot to bring the Constellation's command structure into the log along with the air wing command. This would unite all of the major commanders within one operational log.

The Chosin was another matter altogether. One of the researchers spent four days on the ship piecing together the failed transition. The computer systems officer was hesitant at first to admit that they were no longer using the log application. Instead, he had taken it upon himself to create this functionality within a distributed groupware database. Upon further investigation, the researcher found that they had never even initiated use of the collaborative log system.

The database application that the officer had created was more specialized. He explained that among the crew there were several watch positions that needed to maintain logs. The chronology of these logs was not the important issue. Primarily, only the current status of the situation and the weapons systems was of importance.

The researcher found that instead of the chronological listing of events that could be found in the TFCC log, the Chosin's logs were more akin to bulletin boards. Here the watch standers would simply update the status of a fixed set of parameters. This focus on the immediate situation is understandable when viewed in terms of the Chosin's mission.

As the task force's air defense command, the Chosin was tasked with responding instantly to potential air threats to the flotilla. A minute's hesitation could spell disaster for the task force if an enemy missile or aircraft was to slip through the defensive screen. The Constellation, on the other hand, was more concerned with the long-term management of the task forces' assets and the tracking of slow moving shipping through the Persian Gulf. Initially, the research team felt that the needs of the watch standers were similar. It turned out that they were quite different.

5.4 Deployment Completion

The end of the deployment evaluation of collaborative log usage was complicated for the researchers by the immediate breakup of much of the staff team. After six continuous months at sea, the commands all took a much-needed break. This is also a prime time for reassignment to new positions in the Navy. Thus, it was difficult for us to find and interview many of the people that could lend insight and complete the story.

We did, however, get to speak with many of the key players and we were able to get the entire text of the TFCC log from the deployment. We noted the following things. First, the log never did expand to include the ship or the air wing. Second, the TFCC log continued to be refined as its usage became ingrained in the standard operating procedures of the staff and commanders. Most important to our research, we found that the staff felt that the collaborative logs should be a standard application for all such task forces. This led to the installation of the application on Constellation's relief, the USS John C. Stennis.

The final interview of the destroyer squadron commander revealed a number of system attributes that the Constellation team came to value. This did not really impact the technology transition per se. By the time the system users had reached this level of complex usage they had already been using the log application for some time. We did, nonetheless, feel that we could call these new uses to the attention of prospective adopters.

6.0 Discussion

The two experiences with the Constellation and the Chosin are interesting in that although the two crews received the same application, the same support materials and similar training, the outcomes were very different. The Constellation crew never skipped a beat with regard to the use of the collaborative logs. The Chosin, on the other hand, almost immediately abandoned the use of the application and developed their own solution. Although, the researchers could not have predicted this exact turn of events, the outcomes do make sense when viewed with respect to the TTM. After the installation, the research team was quite concerned about the success of the Chosin fielding.

The research team utilized the Technology Transition Model to guide their decisions with regard to the implementation of the log application on the two ships. Following is a point-by-point account of how each variable within the model was assessed. This will then be followed by an explanation of why the two situations had such different results within the framework of the TTM.

6.1 Perceived Magnitude of Value

The value of the collaborative logs on the Constellation was apparent from the start at many levels. First off, the admiral had been the initiator of the effort to bring the log system onboard. This put a lot of political emphasis on the project. It also had immediate buy in from the destroyer squadron commander who had used the system extensively while he was assigned to Third Fleet staff.

The TFCC log also afforded the staff the ability to easily track the movements and contacts with shipping over the long term. This helped them to perform post hoc research into UN sanction violations. Additionally, the users saw the capability to record their own processes in the log. This allowed them to revisit their judgments and assumptions so that they could improve future decisions and change processes. Ultimately, the greatest value was in the ability to break down barriers to communication between the staff members and the commanders.

On the Chosin, the users did not see any intrinsic value in using the log application. The plan was pushed down from the leadership. Because the watch standers already worked in the same space, there was no pent up demand for better communications. The users even viewed the logs as an intrusion that would not help them to perform their jobs.

6.2 Perceived frequency of net value

The task force staffs on the aircraft carrier used the logs to record the minute-to-minute progression of their operations. As such, a typical day would have over two hundred entries. The logs allowed for a continual recording of the critical events of the day. Users experienced a very high frequency of benefit. The leadership, in turn, utilized the logs regularly so that they did not have to upset the rhythm of the watch standers to refresh their operational awareness.

The Chosin crew needed a place to store the status of the different weapons systems and ship's status for quick consumption. This primarily took place on watch changes every four to five hours and when the captain specifically asked for an update. They had little need for a constantly updated chronological progression of events. In addition, the potential consumers of the information were located in the same place where it was easier to ask a question than review a log.

6.3 Certainty

Among the task force staffs, the value of the collaborative log application was fairly certain from the start. The only real confounding factor was that of the potential for interference and micromanagement that might decrease the net value of the transition.

On the Chosin, there was low certainty of benefit. For the most part the users were not distributed throughout the ship and communication was already quite good. This led to feelings that gain was not apparent for the watch standers. The commander was certain that some automation should take place, but he was not sure that the log system would provide what he needed.

6.4 Perceived Net Value of Transition

The admiral, squadron commander and staffs generally felt that there would be immediate and widespread gains from the transition. The previous system involved a great deal of legwork and coordination. The commanders had to regularly interrupt the watches to find out what was happening. The collaborative logs would provide the staff with, as the destroyer squadron commander stated, a "snapshot" of the current situation at any given time with very little cognitive or physical overhead.

The watch standers saw immediate value because it let them concentrate on their work. The only threatening resistance came from those that feared abuse of the system and a few people that wanted more face to face time with the admiral.

The Chosin's leaders saw some slight value in recording the information online. They did not feel, however, that this benefit outweighed the hassle of dealing with another application. The current system worked well and already had low barriers to communication.

6.5 Behavioral Intentions

In hindsight, it is very clear that the tangible benefits, frequency of value and relative ease of transition made the successful technology transition on the Constellation a sure bet. On the Chosin, this was not the case. In spite of the research team's best efforts, the tasking of the ship and the context of their environment did not make the transition a foregone conclusion.

Following is a chart that briefly summarizes the two installations with regard to the variables associated with the TTM.

	USS CONSTELLATION	USS CHOSIN
PERCEIVED MAGNITUDE OF VALUE	HIGH – Several large staffs coordinating operations over time and tracking ships evading UN sanctions over months at a time; political value	MEDIUM – small tightly knit combat staff all working in the same area, logs used as a status board for instant action
PERCEIVED FREQUENCY OF NET VALUE	HIGH – entries were made for every major action of the task force in addition to regular scheduled entries; senior leaders regularly reviewed the logs	LOW – chronological entries were not important and status entries would change sporadically; commander would often be collocated with the watch standers and did not require the system
CERTAINTY	MEDIUM – leaders instinctively saw benefit; some users initially felt the system would cause problems	LOW – leaders knew that some system was desirable; users did not feel that benefit was probable
PERCEIVED NET VALUE OF TRANSITION	HIGH – previous mechanism for coordinating and maintaining situational awareness was slow, cumbersome and caused errors	LOW – previous system worked well and did not gain greatly from a transition
BEHAVIORAL INTENTIONS	Staffs and commanders were immediately committed to making the transition	Half-hearted commitment from leaders; little effort on the part of users
RESULTS	Complete and successful transition to the application	Abandonment of the application; transition to a similar system that better met specific needs

Table 1. Summarized Technology Transition Model Variable Assessments for the USS Constellation and the USS Chosin

7.0 Significance

This paper chronicles the experiences of a two-person research team working to establish a GSS on two ostensibly similar platforms. The reality of the situation turned out to be somewhat more complex. The team was somewhat naive about the differences between the ships, their missions and the needs of the respective users. As was stated in the text, the installation on the Chosin was done with little planning or understanding of the specifics of the environment. In our haste, we accepted this challenge and jumped in. Perhaps, armed with a better understanding of the Chosin, the team would have had greater success.

Although it is a relatively new and untested model, these two cases can be interpreted to lend credence to the TTM. The Technology Transition Model seems to generally explain the behavior observed by the researchers. The researchers followed many of the prescriptions laid out by Briggs, et al when performing this research. They were not able, however, to outweigh the context of the two situations. Though we have found the TTM to be a useful tool in our fieldwork, it still requires extensive testing, both quantitative and qualitative.

8.0 References

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