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PORTFOLIO MANAGEMENT DECISION SUPPORT TOOLS ANALYSIS RELATING TO MANAGEMENT VALUE METRICS

by

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PORTFOLIO MANAGEMENT DECISION SUPPORT TOOLS ANALYSIS RELATING TO MANAGEMENT VALUE METRICS

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I. INTRODUCTION

The Department of Defense has become very adept at managing assets in both war and peacetime operations including movement of logistical supplies, battle groups, personnel and information systems. These assets are tangible and the metrics appear to be relatively well defined for measurement of performance allowing adjustments to be made that attempt to maximize the capabilities in any given operating environment. The intangible asset, management, which is required to ensure these important activities are executed at the appropriate time and place, is not considered in the metrics that are currently utilized. It follows, that questions can be posed, such as, "What is the value added by information technology to support Maritime Domain Awareness?" And, "How much value does management add to the execution of these tasks and what is the Return on Investment (ROI) for management's involvement?"

In order to evaluate the effectiveness of management and the accompanying ROI, a new approach to measurement must be considered that will take into account the value of intangible assets like routine, explicit knowledge and management's unique creative intuitive knowledge and convert the results into common units of output across the enterprise to enable comparability of estimates. The measurement tool will take into account the performance of organizational assets including personnel, processes, and technology. The approach must also account for intangible assets such as knowledge, and intellectual capital. Knowledge value added (KVA) provides a methodological framework for measuring the value added of these assets as they convert inputs into outputs. With this approach it is possible to describe all process outputs in common units. Using the traditional valuation technique of "market comparables," it is possible to assign a price per unit of output that enables the use of common financial metrics such as discounted cash flow, net present value, ROI. Further, the KVA framework can be used to calibrate management's creative outputs in terms of the amount of time it takes an average manager to learn how to make these kinds of decisions through formal and informal education, training, and experience.

Using this technique, a value can be determined for intangible assets such as management's creative activities that have been labeled "management dark matter" (Housel and Kanevsky, 2007). Further, this new source of data can be used, not only to conduct analysis on the value of management, but may also be used to structure options for future strategic planning within an organization.

The measurement framework selected was developed at the Naval Postgraduate School (NPS) by Dr. Thomas Housel and Dr. Jonathan Mun. The approach utilizes the Knowledge Value Added and Real Options (KVA+RO) valuation framework and addresses the difficulty in measuring intangible assets such as management. The KVA+RO analysis was originally designed to measure IT portfolio acquisitions and allow for the development of real options utilizing Monte Carlo simulation and portfolio optimization techniques to estimate the risk-return tradeoffs. This valuation allows decision makers to look at the options available to them to maximize return on investment while ensuring optimization of resources and risk mitigation.

This thesis extends original work by Housel, Bell, and Kanevsky on the KVA framework by demonstrating that it can be adapted for use in the valuation of management in the same manner it is utilized to value other productive assets within processes. The research will begin with a discussion of current management valuation reports and how they fail to provide defensible estimates of the value added by individual managers in a comparable, objective way that can be effectively utilized by decision makers. The KVA+RO valuation framework will be discussed in detail in the Second section to demonstrate how this framework can be used to place a value on all productive assets. The Third section will be a demonstration of the extension of the KVA methodology to measure the value added by management using a case study of the Maritime Domain Awareness (MDA) Track Generation process. The case study provides a proof of concept of the use of a new measure of management's value added within the context of the existing KVA approach and will demonstrate the ability to value productive assets, including managers, and utilize that valuation to recognize the options available to decision makers. This section will also demonstrate how the KVA data can be used to inform the analysis of real options. Section Four will be a discussion of the results from the proof of concept and how the results can be utilized to provide a metric for management and empower decision makers with options steering away from subjective analysis of management performance and replacing it with a defensible and objectively derived quantitative value. Section five will discuss utilizing the KVA approach to measure the value added by management within the context of the MDA proof of concept. The discussion will cover how valuation of management can be approached using the KVA methodology and how decision makers can be more effective at understanding the value of management within an organization. Section Six will discuss recommendations for implementation of this technique, limitations and future research on the subject matter.

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II. PRESENT DAY IDEAS OF VALUATION

Industry leaders recognize a need to show the value of management but most of the research done focuses on whether or not management has an effect on the overall organizational value or how the value of an organization can be increased with management. The research does not look at the effect of individual managers on an organization or objective metrics to measure the value added by those individual managers. The literature reviewed will be briefly discussed to further demonstrate the need for a metric allowing us to perform a valuation of managers enabling decision makers to see how much value a manager adds to an organization.

"Does Corporate Governance Effect Firm Value?" was the question posed by Black, Jang, and Kim (Black, et al., 2003). They answered this question by developing a corporate index of 526 Korean companies and conducting statistical analysis to find a correlation between corporate governance and firm value. A key factor in this research is "that the index is based on information obtained on shareholder rights, board of directors in general, outside directors, audit committee and internal auditor disclosure to investors, and ownership parity" (Black, et al., 2003, p. 3). It is important to note the index used in this research because it demonstrates that the manager as a single entity is being overlooked when calculating the effect management governance has on an organization's value. The decision maker will only know if the governance of the management team as a whole had an effect on a firm's value and not if the management team or a particular manager had a significant contribution to the organization's value. The results of the analysis demonstrated a strong positive correlation between corporate governance and firm value which emphasizes that decision makers need to be able to apply a metric to the management team and individual managers so they will be able to further exploit an organizations assets and potentially further increase the organizational value.

Beiner, Stefan, Wolfgang Drobetz, Markus Schmid, and Heinz Zimmerman conducted similar research on corporate governance and the valuation of specific firms which also demonstrated a positive relationship. The research did not isolate any one manager or management function. The researchers used an index constructed of Swiss firms based on a broad corporate governance index and applied five additional variables related to ownership structure, board characteristics, and leverage to provide a comprehensive description of firm-level corporate governance (Beiner, et al., 2006). The research results show that corporate governance does indeed have a distinguishable effect on firm value, but does not allow a decision maker to distinguish whether the management team as a whole or individual manager contributed to the additional firm value. The decision maker is forced to assume that the team as a whole contributed to the increased firm value and in actuality it may only be a small portion of the management team's contributions that are causing the value to increase.

A slightly different approach was used in Klein, Peter, Shapiro, and Young's attempt to assess a correlation between corporate governance and firm value with an emphasis on family ownership of a company. The companies used in the research were Canadian, but in many cases were traded on a United States Stock Exchange as well. When looking for variables to conduct the analysis the authors noted the difficulty in finding good "instruments" to work with for assessing the correlation of firm value based on corporate governance (Klein, et al., 2005). The two variables that were selected were whether or not the company was traded in a United States exchange and how long the company had been traded on the Toronto Stock Exchange. The results of the research did not demonstrate a positive correlation as with the previous two studies and in fact the researchers found that corporate governance did not seem to be a factor for the companies in Canada. The data would be difficult information for a decision maker within a corporation to comprehend because it would not allow for a reasonable assessment of the effectiveness of the firm's management team and how to address either increasing or decreasing organizational value. The question might arise: Is a management team required for the organization if this study was indeed accurate? The only way to truly know the effectiveness of a management team or manager is to independently find a way to measure that intangible entity separating it from other factors such as corporate governance.

Hsiu Ting conducted research on corporate governance in Taiwan utilizing the factor of poor economic conditions. The first thing Ting did was acknowledge that some previous studies found that corporate governance did not have a factor on firm value and then conducted his own analysis to confirm whether or not there was a correlation. Ting conducted statistical analysis of 207 companies utilizing a simple summary factor and concluded that there was indeed a correlation between corporate governance and firm value. The research further found that “firms with poor corporate governance mechanism tend to perform badly when business cycle goes downward” (Ting, 2006). The most important find related to this thesis research is that Ting also found that “the recognition of supervisor is an important factor for corporate governance effect as well” (Ting, 2006). This factor is important because it emphasizes the need for a metric that can be used to assess a manager’s performance and the assumption can be made that the performance does contribute directly to the value of a firm.

Michael Armstrong has written a guide for managers to utilize called A Handbook of Management Techniques. The guide specifically talks about value adding skills and technique for managers and breaks them up into different management specializations. The driving force through the guide is to improve the manager through better decision making, various methodologies leading to improved effectiveness. The dilemma is how does a decision maker assess how much added value to the organization will the manager be or has become without the metric to measure his or her performance.[1]

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[1] Thomas Housel and Kanevsky, Valery, *“Measuring the Value Added of Management: A Knowledge Value Added Approach”,* Working Paper, Not Yet Published, 2007

This thesis encompasses key components in the development of a methodology to measure Management Value Added (MVA) and begins with the Knowledge Value Added (KVA) methodology described within the book Measuring and Managing Knowledge by Dr. Thomas Housel and Dr. Arthur Bell (2001). The literature discusses the shift in paradigm as we enter the information age and the importance of knowledge being managed as an asset even though it is considered an intangible asset. An important concept that is stressed in this literature is the assumption that there is a direct relationship between knowledge and the value it creates (Housel and Bell, 2001). This concept allows the current thesis research to demonstrate the idea that knowledge does equate to value and that if management implicit knowledge can be described then it can be measured and translated into a value that can be associated with the cumulative value produced by an organization. The Knowledge Value Added (KVA) approach was used to conduct a case study as part of the research for this thesis. This approach is explained in the literature as a methodology to estimate the value of knowledge deployed throughout a company's core processes (Housel and Bell, 2001). The value added is calculated by utilizing a "return ratio with the numerator of the ratio being the percentage of the revenue or sales dollar allocated to the amount of knowledge required to obtain the outputs of a given process in proportion to the total amount of knowledge required to generate the corporation's salable outputs" (Housel and Bell, 2001, p. 40). The denominator of the ratio is the cost to execute the process knowledge.

The next piece of key literature supporting this research is Real Options Analysis by Dr. Johnathan Mun. Real Options theory allows an organization to make decisions looking at all options available to them. "Traditional discounted cash flow approaches assumes a single decision pathway with fixed outcomes, and all decisions are made in the beginning without the ability to change and develop over time" (Mun, 2006, p. 92). The theory utilizes the value we are able to apply to knowledge through Knowledge Value Added methodology and conduct Monte Carlo simulation which ultimately provides decision makers with multiple options for an organization. The options may be simplistic in nature or give the organization numerous options allowing the organization to execute projects at the most advantageous time to gain maximum benefit and value. Real Options theory is the second component to the KVA+RO framework utilized in the case study to demonstrate the ability for one to place value on an intangible asset such as knowledge and utilizes this asset in decision making to increase the value of an organization.

The next step is to lay the groundwork for utilizing a similar approach to value management implicit knowledge as an intangible asset and develop a metric to consistently measure that value against the organizational value to determine how much contribution can be associated with the manager and/or management. The cornerstone piece of literature for this thesis is a white paper titled Measuring the Value Added of Management: A Knowledge Value Added Approach by Dr. Thomas Housel and Dr. Valery Kanevsky (2007). The working paper looks at the increasing use of an open business model used in organizations today. The model attempts to address the increasing burden on management based on the amount of complexity managers must deal with by attempting to mitigate risks, resolve uncertainties, improve predictions, and exercise the control and oversight necessary to be successful (Housel and Kanevsky, 2007).

In relation to this thesis work, this aspect is important as we address the value of managers and how decision makers can become empowered with a metric to see how well a manager is performing in the increasingly complex environment and be able to correlate that to the overall value of the organization. “The idea of management dark matter is introduced in this literature as the use of manager’s creative insights when they attempt to predict the future, create potential pathways to accomplish the predictions, and control for future risks. Those activities that are uniquely associated with management involve the creative use of decision heuristics based on their implicit knowledge accumulated over years of experience, training and education” (Housel and Kanevsky, 2007,

p. 5). This concept is important to understand as we help to further this methodology with the case study and explanation of how the Management Value Added approach can be applied.

III. OVERVIEW: KVA+RO FRAMEWORK

"KVA measures the value provided by human capital assets and IT assets by analyzing an organization, process or function at the process-level" (Housel and Mun, 2007, p. 7). It provides insights into each dollar of IT investment by monetizing the outputs of all assets, including intangible knowledge assets. An output is defined as the end result of an organization's operations; it can be a product or service as shown in Figure 1.

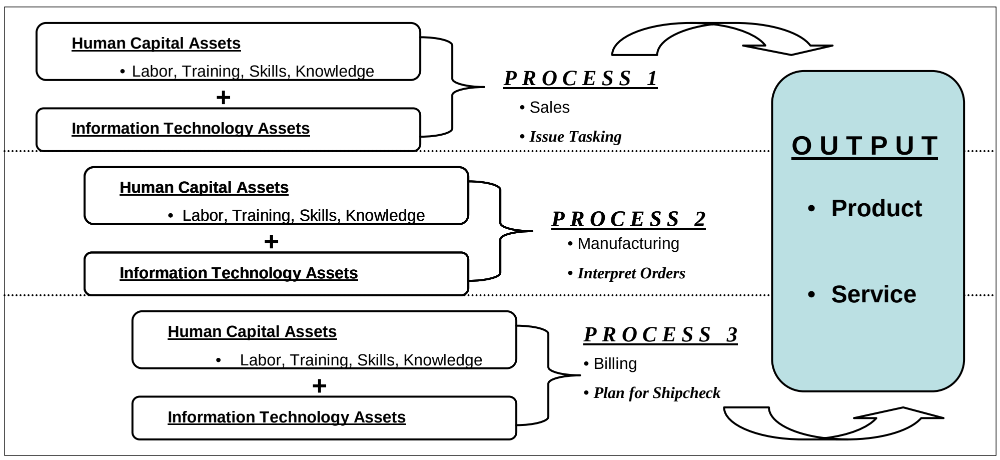

Figure 1. Measuring Output (From: Uchytil, 2006)

KVA is designed to assist organizations such as the Department of Defense manage IT investments and risk mitigation. The framework's key components are data collection, KVA methodology, and Real Options analysis that collectively provide the basis for performance data and analysis on individual projects, programs and processes within a portfolio of IT investments (Housel and Bell, 2001). There are three methods that KVA analysis can be conducted, as shown in the Table 1.

Table 1. Three Approaches to KVA (From: Housel and Bell, 2001)

Steps	Learning Time	Process Description	Binary Query Method
1		Identify core process and its sub processes.	
2	Establish common units to measure learning time	Describe products in terms of instructions required to reproduce them and select unit of process description.	Create set of binary yes/no questions such that all possible outputs are represented as sequence of yes/no answers.
3	Calculate learning time to execute each sub process.	Calculate number of process instructions pertaining to each sub process.	Calculate length of sequence of yes/no answers for each sub process.
4		Designate sampling period long enough to capture representative sample of core process's final product/service output.	
5	Multiply learning time for each sub process by number of times sub process executes during sample period.	Multiply number of process instructions used to describe each sub process by number of times sub process executes during sample period.	Multiply length of yes/no string for each sub process by number of times this sub process executes during sample period.
6		Allocate revenue to sub processes in proportion to quantities generated by Step 5 and calculate costs for each sub process.	
7		Calculate ROK and interpret results.	

A. DATA COLLECTION: KVA METHODOLOGY

The KVA methodology was used to fulfill the requirements for this thesis as the research project progressed and Maritime Domain Awareness (MDA) Track Generation processes unfolded over a period of approximately eleven months. The initial phase began with Knowledge Value Added (KVA) data collection obtained through interviews with MDA management and MDA process Subject Matter Experts (SMEs). Observations were made to obtain average learning-time estimates and the number of roughly equivalent MDA process instructions required to complete each sub-process. There was an evaluation of the framework for measuring the value of cost and benefit of each system within each Maritime Domain Awareness (MDA) process and sub-processes required to produce an output. Once MDA process data was accurately documented, it was supplemented by additional research to compare cost of each MDA process and revenue data to establish baseline information. KVA methodology was then applied to uncover the value of Maritime Domain Awareness (MDA) Track Generation and historical costs for each process. Cost per unit of output was calculated by KVA in conjunction with price per unit estimates (based on a market comparables analysis) that provided raw data required for ROI analysis (Housel and Bell, 2001).

B. GAUSSSOFT KVA SOFTWARE

The second phase involved the use of GaussSoft KVA software that was utilized to extract an array of KVA data input: Cost of Employees, Revenues, Total Learning Time, Information Technology, and Times Fired. A predetermined set of Outputs (Track Generation, Track Quality Assurance, Data Cleansing, and Data Acquisition), were used to make strategic, and operational decisions in analyzing the economic performance and cost-benefit relation associated with the Maritime Domain Track Generation operational processes.

In Figure 2, there is a profitability model created with GaussSoft KVA software for the Maritime Domain Awareness (MDA) process. The resources contained the knowledge to produce outputs.

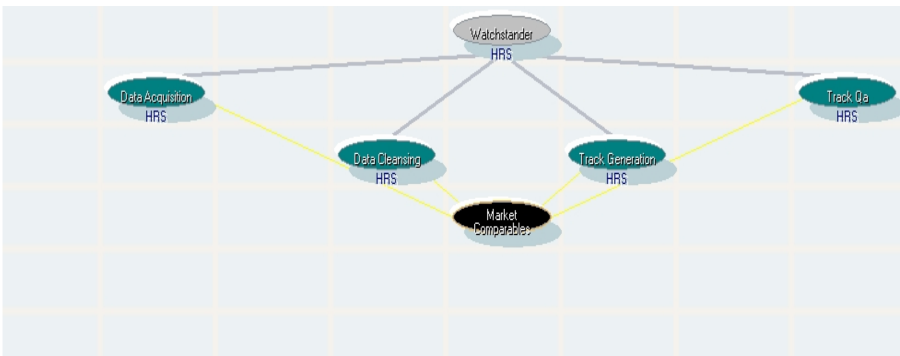

Figure 2. Profitability Model

Time to Learn describes the amount of time it takes an average person to learn a process. The Time to Learn Model indicates 13.33 weeks for Track Generation, 3.33 weeks for Track Quality Assurance, 2.22 weeks for Data Cleansing, and 1.11 weeks for Data Acquisition, as shown in Figure 3. So an average MDA watch stander would take longer to learn the Track Generation portion of the MDA process in order to execute it properly. It takes less time to learn Data Acquisition.

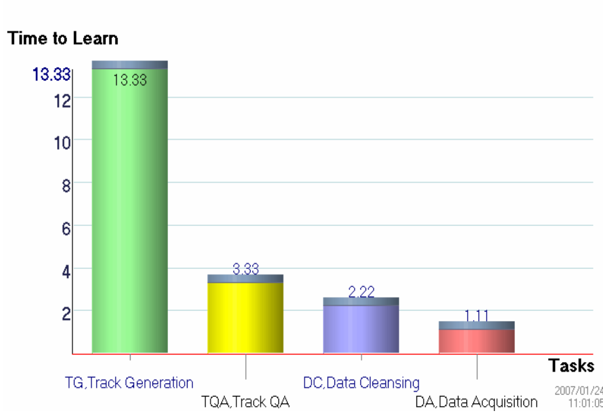

Figure 3. AS-IS Time to Learn Model

The KVA model indicates a Track Generation of 4.47m, Data Cleansing of 828.8k, Track Quality Assurance of 372.96k, and Data Acquisition of 4.24k, as shown in Figure 4. Even though Track Generation takes a longer time to learn, it returns a higher value of knowledge using KVA methodology, but a lower return on Data Acquisition.

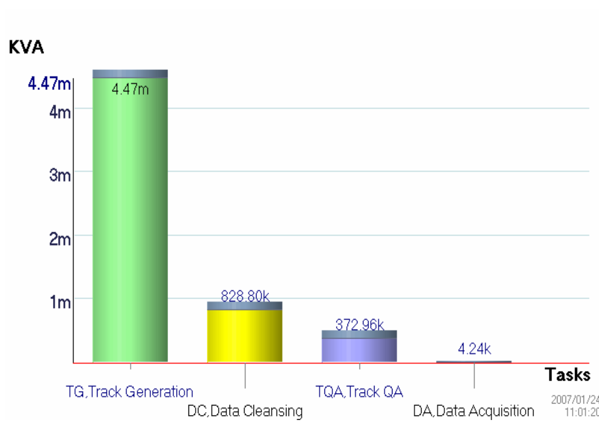

Figure 4. KVA Model

Market Comparables is the valuation approach that can be used to estimate price per common unit, based on market comparable revenue for process outputs. The Market Comparable model indicates a Track Generation of $69.7k, Data Cleansing of $5.85k, Track Quality Assurance of $-2.1k, and Data Acquisition of $-8.5k, as shown in Figure 5. Track Generation and Data Cleansing shows the most value in the Maritime Domain Awareness organization. Track Quality Assurance and Data Acquisition take a substantial loss of MDA process outputs.

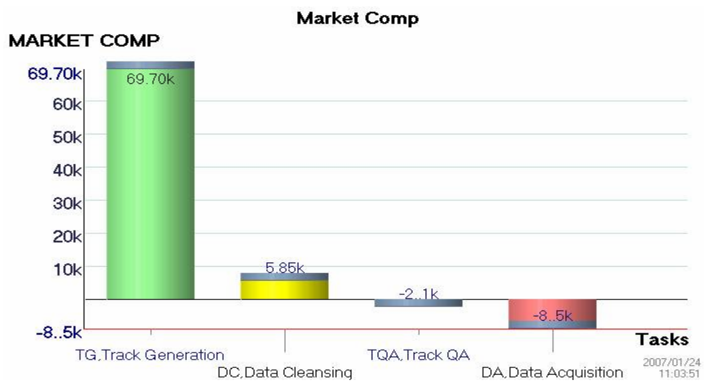

Figure 5. Market Comparable Model

C. REAL OPTIONS

Real Options analysis incorporates strategic planning, risk assessment and management, and investment analysis. Strategic planning affords decision-makers the ability to leverage uncertainty, limit risk, and generate numerous options to increase the value of a project while managing the risk mitigation (Mun, 2006). As a financial valuation tool, Real Options allows organizations like the Department of Defense to adapt to decisions of response to unexpected environmental or market developments (Mun, 2006).

Figure 5 shows Dr. Johnathan Mun's integrated risk analysis process up close into eight simple steps:

1. Qualitative management screening.
2. Time-series and regression forecasting.
3. Base case KVA and net present value analysis.
4. Monte Carlo simulation.
5. Real options problem framing.
6. Real options modeling and analysis.
7. Portfolio and resource optimization.
8. Reporting and update analysis

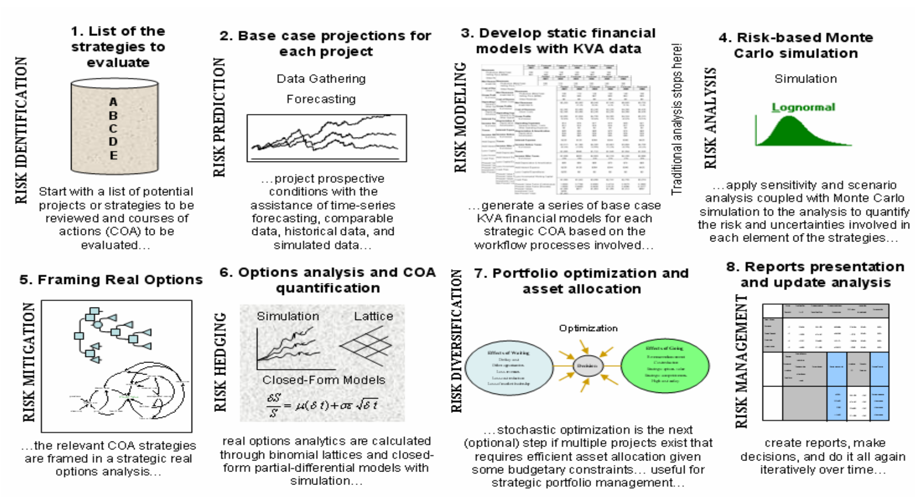

Figure 6. Integrated Risk Analysis Process (From: Housel and Mun, 2007)

In the ensuing stages of the framework, Real Options in the case of this thesis examined the Maritime Domain Awareness (MDA) potential opportunity for an investment which identified the value of the MDA process options through ongoing investments incorporating the outcomes and flexibility in decisions. Dr. Johnathan Mun's Real Options software was utilized using the Lattice and Monte Carlo simulation portion. The MDA process was broken down into four options:

Strategy A: AS-IS option was used to evaluate the current system in place.

Strategy B: Implementing the TO-BE all at once for immediate development.

Strategy C: Implementing the MDA process in two different stages from both the East and West Coast.

Strategy D: Implementing the TO-BE Radical Development.

There was a set of inputs utilized for the above options: PV asset, Cost to Execute, Timing and Volatility. We used a discount rate of 5% and present value of asset of 20 years of revenue. Cost to Execute was based on a scalar factor of how much the revenue would be. Timing was based on the assumption that the system will last 20 years. Volatility was based on simulation of various average learning times and the standard deviation divided by the mean value. By applying the Monte Carlo simulation to these options, it allowed change to all major inputs in an efficient manner within this model, and the ability to identify, quantify, and analyze risk mitigation. The resulting values were compared to various MDA scenarios to assess potential improvements and how it could be applied in a broader sense to management, and whether or not it brings added value to any given Maritime Domain Awareness process. In Chapter IV, the results will show the proof of concept and the value of KVA+RO analysis.

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IV. KVA+RO RESULTS

The KVA analysis of the MDA implementation revealed that the radical approach involving the implementation of the developed software and associated systems on both East and West Coast Maritime Intelligence Fusion Centers will vastly improve the Return on Investment (ROI) for the implementation and enable the fusion centers to increase the volume of data they are currently able to handle.

A. SUBSTANTIAL REVENUE GENERATION

The investment in the development of this is minimal in comparison to the potential generated revenues from the implementation of the track generation software developed by Naval Research Laboratories. Table 2 below provides estimated revenues based on the data collection from the track generation system in live operation during both the "AS IS" and single phase TO-BE implementation. The potential for the second phase (Pacific) implementation increasing the volume handling capacity of the system allows for an exponential increase in track generation which correlates to a substantial revenue increase.

Table 2. KVA Results - Analysis of Revenues (Annualized)

	Process Title	"AS IS"	"TO BE"	"RADICALTO BE"	*"AS IS" & "TO BE" Revenue Differential*	*"AS IS" & "RADICAL" Revenue Differential*
1	**Data Acquisition**	$2,713.94	$10,847,273.98	$397,161,466.92	$10,844,560.04	$397,158,752.98
2	**Data Cleansing**	$529,548.62	$2,277,927.54	$83,403,908.05	$1,748,378.92	$82,874,359.43
3	**Track Generation**	$953,187.52	$569,481.88	$20,850,977.01	($383,705.64)	$19,897,789.49
4	**Track QA**	$238,296.88	$1,016,931.94	$37,233,887.52	$778,635.06	$36,995,590.64
	Totals	$1,723,746.96	$14,711,615.34	$538,650,239.51	$12,987,868.38	$536,926,492.55

B. IMPROVED PROCESS PERFORMANCE

All of the sub-processes are improved with the implementation of the developed information technology but the most important sub-process to note is track generation. Figure 7 shows that track generation is significantly increased with the implementation of the new track generation technology with track generation increasing by over two hundred times the capability of the AS-IS system. The significance of the increased number of tracks is that the amount of information available to the intelligence community customer is vastly increased allowing for improved situational awareness.

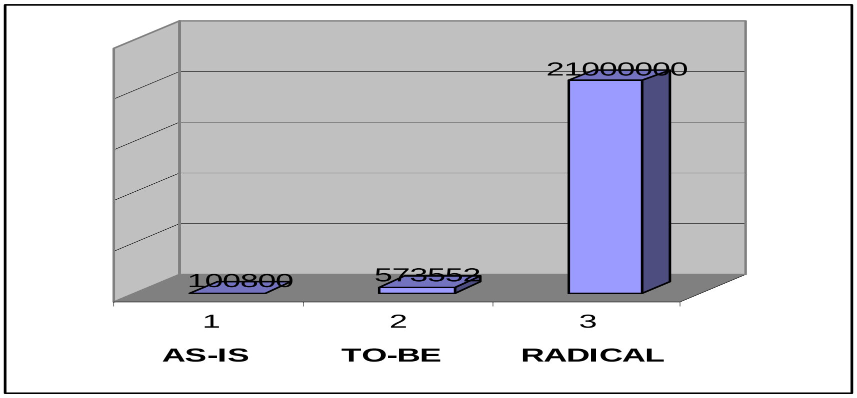

Figure 7. Tracks Generated (per week)

C. RETURN ON KNOWLEDGE

The Return on Knowledge (ROK) metric allows for value to be placed on the knowledge contained within both the information systems and the personnel who are a part of the process and/or sub-processes. The metric allows for the conversion of that knowledge into a quantifiable unit which empowers decision makers to make informed decisions on processes based on the value which it holds. The KVA analysis demonstrates the ROK for the implementation of the newly developed technology significantly increases with both the TO-BE and Radical implementation. Table 3 provides a break down of the ROK for each implementation broken down by each sub-process.

Table 3. KVA Results - Analysis on ROK

Core Process	Process Title	"AS IS" ROK	"TO BE" ROK	"RADICAL" ROK
1	Data Acquisition	1.21%	4824.52%	176544.52%
2	Data Cleansing	235.53%	1013.15%	36995.35%
3	Track Generation	423.95%	253.29%	9173.84%
4	Track QA	105.99%	452.30%	16460.42%

The increase in ROK indicates more efficient firing of the knowledge within each process. The large percentages may seem exaggerated but they are a reflection of improved knowledge utilization contributed to the new technology implementation.

The application of KVA allowed discounted cash flow estimates that make Real Options analysis feasible. The Real Options framework uses a statistical analysis risk management approach to estimating the risk-rewards of the four options that were being considered for this project. The data was placed in a lattice structured after the options being considered were selected. These options included: leaving the system in an AS-IS state, immediate development of new technology, two stage development of new technology and radical development and deployment of the technology. The statistical analysis conducted also known as Monte Carlo simulation included five thousand trials to ensure reliable results. The key for real options analysis is to find the value for each option and enable the decision maker to make informed decisions that increase the potential Return on Investment.

The results indicated that strategy D, radical development, was the best strategy to follow of the four options considered. The results account for increased volume of contacts based on overall improved system performance from the newly implemented technology. The results from the Real Options analysis are depicted in Table 4.

Table 4. Real Options Analysis

Options	NPV	Total Strategic Value
Strategy A	6.3 Million	6.3 Million
Strategy B	121.9 Million	140.5 Million
Strategy C	51.6 Million	60.1 Million
Strategy D	14.9 Billion	25.0 Billion

V. MEASURING MANAGEMENT

The KVA analysis of the MDA track generation process options provide proof of concept that intangible assets can be accounted for within an organization. The question remains how we account for the dark matter or intuitive (i.e., non-algorithmically definable) heuristics that allow a manager to make creative management decisions that predict the future and potentially add value to an organization? Dark matter accounts for a portion of the manager's activity and includes "the use of managers' creative insights when they attempt to predict the future, create potential pathways to accomplish the predictions, and control for future risks and uncertainties. Those activities that are uniquely associated with management involve the creative use of decision heuristics based on their implicit knowledge accumulated over years of experience, training and education" (Housel and Kanevsky, 2007, p. 3). Figure 8 shows a track generation process.

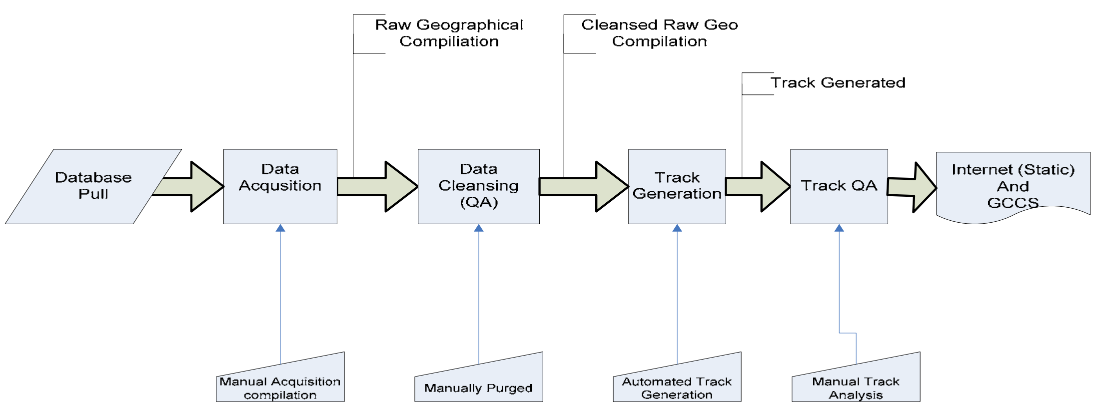

Figure 8. Track Generation

Management Value Added is structured within the methodology of KVA and accounts for the dark matter outputs from manager's creative knowledge and allows us to estimate the amount of dark matter output for each manager.

The example that will be used to demonstrate this concept is the management of the track generation within the Maritime Fusion Intel Centers. The watch officer and watch supervisor will generate dark matter outputs continuously while managing tracks generation to:

- mitigate the risk of false information,
- avoid poor fusion of data points into tracks,
- identify tracks that require immediate attention
- notify those that have a need to know and understand the legalities of the information being generated.

To be successful managers of the track generation process, they must utilize their dark matter along with their routine management activities to ensure timely delivery of a quality intelligence product to customers in an operational environment.

We measured the dark matter outputs that the watch officer utilized by:

1. First, segmenting their job description into "dark matter required" activities (e.g., finding a discrepancy or ambiguity in generated tracks based on their experience when they "smell" something wrong) and routine management activities (e.g., QA check track reports, posting track information to various web sites)
2. Second, estimate the learning time required to teach a novice manager how to perform each routine and dark matter based activity
3. Third, the number of times that the dark matter outputs were generated within 100,800 tracks generated (see Tracks Generated figure xx) per week

The results indicated that of the 100800 tracks generated, 6% raised concerns based on the managers experience that required further investigation. They indicated that these tracks just didn't "smell right" (i.e., made non-navigational sense). Identifying these problematic tracks required managers to use their intuition, implicit knowledge to predict a possible false identification of a track. This dark matter ability to predict a possible problem with a track is critical because it dramatically affects situation awareness of the customers of this information in the operational environment. For example, an experience track manager would recognize that certain tracks were false tracks and not a contact of interest thus improving the allocation of scarce operational units to investigate and monitor actual contacts of interest.

The amount of learning time required to teach new managers with college degrees how to “smell” problematic tracks was six months of on the job training and one week of formal training or 25 weeks. This dark matter knowledge fired 6000 times per week multiplied by 25 units of learning time equals 150,000 units of dark matter output. By multiplying the price per unit of outputs, i.e., $.0136, times the total dark matter outputs of 150,000 the value of the dark matter activity of the managers was estimated to be $2040 per week. This represents the estimated value of the track manager’s dark matter. Table 5 shows the results of the MVA test concept.

Table 5. MVA Results – Simple Concept Test

Learning Time (in weeks)	Dark Matter Fired	Total Units	Cost Per Unit	Estimated Value (per week)
25	6000	150,000	$.0136	$2040

This is a test of concept of the approach to estimating the value added by manager’s dark matter in the context of this case example. The example provides a metric in which decision makers can assess the value added by managers to an organization and estimate the potential and historical revenues that might be generated by the firing of the manager’s dark matter. This information allows decision makers to look at future strategies and improve the utilization of management to continue to increase the value added to the organization. The example is simple demonstration of the application in this breakthrough concept and requires further testing to include the use of the correlation method as discussed in Dr. Thomas Housel and Dr. Valery Kanevsky’s white paper. The results could potentially be more dramatic in a more turbulent environment, e.g. point of the spear battle space.

This research calls into the question the accuracy of KVA based estimates that did not include dark matter. However, the possibility exists that all the outputs were captured in the KVA based estimates because the dark matter outputs are realized in the final product.

VI. LIMITATIONS/FUTURE RESEARCH AND RECOMMENDATIONS

A. LIMITATIONS

There should be more data collected over time for the proof of concept methodology and framework providing the value of management in the MDA organization, so we could move towards correlation of further testing for validation of the MDA management, as well as their supportive operational leaders.

B. FUTURE RESEARCH

Future Research should include overcoming the limitations by doing more research in more turbulent domains and pursue correlation test approach that was not utilized in this thesis (see Housel and Kanevsky, 2007). There are future projects in the works that include:

1. KVA+RO framework solution to monitor processes for PEOIWS-1 beginning with data collection of core processes implementing GaussSoft KVA software. The data collection will allow the generation of performance parameters that will be used for Real Options analysis.
2. Future Research utilizing KVA+RO framework to assess the value of knowledge learned from continuous research utilizing FORCENET, which is the future Command and Control system that will provide more robust, reliable, and accurate Common Operational Picture (COP) to Commander's making decisions on the battlefield.
3. Management Value Added (MVA) research should continue that will evaluate the future of management in organizations such as the Department of Defense preventing the risk of poor job performance, new product delivery time, and poor acquisition cost estimates.

C. RECOMMENDATIONS

MDA should move to the next step, meaning if you want a continuous ROI results, you have to monitor the process overtime and continually compute the results against the KVA+RO framework versus sampling only one time as we did in this case study. The continuous sampling will enable decision makers to make a more informed decision with all options considered against aggregate performance feedback. MDA leadership is critical in helping select the options for improvement of the MDA process.

MDA Subject Matter Experts (SME) should utilize capable software such as GaussSoft that would provide a more proficient KVA output for continuous monitoring of MDA processes in the near future.

VII. CONCLUSION

The proof of concept study demonstrated the research approach can be used to value changes through automation to the MDA process of Track generation and it helps top level management make portfolio management decisions for allocating resources for MDA information systems or reallocation based on the ability to exercise the most beneficial option for the organization. Track generation automation helps provide the following improvements:

- faster Track generation of a Maritime Contact of Interest (COI)
- provide the opportunity to improve fleet Maritime Interdiction Operations (MIO) intelligence gathering
- decrease personnel costs by reducing the number of MDA watch standers
- improve productivity in current MDA processes, allowing more U.S. Navy and U.S. Coast Guard ship boardings

This new Track generation automation will help provide increased value in Maritime Domain Awareness (MDA). The technology implementation presents a great opportunity for the Department of Homeland Security, U.S. Coast Guard, and U.S. Navy to maintain their fight on the Global War on Terrorism when conducting Maritime Interdiction Operations (MIO) during peacetime and wartime as the threat of terrorism becomes more unpredictable.

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APPENDIX A. AS IS

Table 6. KVA AS IS Data

MDA Threat ID Tracking Process																	
(MIFC Atlantic)																	
Function		ALT			Percent IT		Total Learning		Times Fired		Number of	Cost/Employee	Total	Num.	Den.	ROK	ROI
		(In Weeks)					Time		Per Week		Employees	Per Week	Valuation				
							(In Weeks)				Per Day						
Data Acquisition	0.8	1	1.2	10%	10.00%	11%	1.11	2410.8	3444	4477.2	6	$720.63	3826.67	$52.19	$4,323.78	1.21%	-98.79%
Data Cleansing	1.6	2	2.4	10%	10.00%	11%	2.22	235200	336000	436800	6	$720.63	746666.67	$10,183.63	$4,323.78	235.53%	135.53%
Track Generation	3.2	4	4.8	67%	70.00%	74%	13.33	70560	100800	131040	6	$720.63	1344000	$18,330.53	$4,323.78	423.95%	323.95%
Track QA	2.4	3	3.6	10%	10.00%	11%	3.33	70560	100800	131040	6	$720.63	336000	$4,582.63	$4,323.78	105.99%	5.99%
							20.00		541044			$2,882.52	2430493.33	$33,148.98	$17,295.12	191.67%	91.67%
Assumptions																	
Work Year:					52 Weeks												
Work Week:					42 Hours										Actual Cost	$20,177.64	(per week)
Watch:					12 Hours										Market Comp.	$33,148.98	(per week)
OJT:					6 Hours per Watch												
Watchstander (E-5 w/8yrs) Annual Income					$28,825.20		(This is the "average" watchstander)								Cost Per Product	=	$0.014
Market Comparable Annual Income					$37,472.76										Total Output	=	2430493.33
															Total revenue surrogate	=	$33,148.98
OJT Apportioning:																	
8 weeks @ 6 hours a day							Formal Schools:										
Data Acquisition		1 Week					2 Weeks (@ 8hours per day)								2430493.333	$33,148.98	$0.0136
Data Cleansing		2 Weeks					Week = 5 days for formal training										
Track Generation		3 Weeks													Price Per Unit	=	0.013638787

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APPENDIX B. TO-BE

Table 7. KVA Actual To-Be Data

Function		ALT			Percent IT		Total Learning		Times Fired		Number of	Cost/Employee	Total	Num.	Den.	ROK	ROI
MDA Threat ID Tracking Process (MIFC Atlantic)																	
		(In Weeks)					Time		Per Week		Employees	Per Week	Valuation				
							(In Weeks)				Per Day						
Data Acquisition	0.8	1	1.2	0.77	85.00%	89%	6.67	1147104.00	2294208	3441312	6	$720.63	15294720	$208,601.42	$4,323.78	4824.52%	4724.52%
Data Cleansing	0.11	0.14	0.17	0.81	90.00%	95%	1.40	1147104.00	2294208	3441312	6	$720.63	3211891	$43,806.30	$4,323.78	1013.15%	913.15%
Track Generation	0.11	0.14	0.17	0.81	90.00%	95%	1.40	286776.00	573552	860328	6	$720.63	802973	$10,951.57	$4,323.78	253.29%	153.29%
Track QA	1.6	2	2.4	0.18	20.00%	21%	2.50	286776.00	573552	860328	6	$720.63	1433880	$19,556.38	$4,323.78	452.30%	352.30%
							11.97		5735520			$2,882.52	20743464	$282,915.68	$17,295.12	1635.81%	1535.81%
Assumptions																	
Work Year:					52 Weeks												
Work Week:					42 Hours										Actual Cost	$20,177.64	(per week)
Watch:					12 Hours										Market Comp.	$33,148.98	(per week)
OJT:					6 Hours per Watch												
Watchstander (E-5 w/8yrs) Annual Income					$28,825.20		(This is the "average" watchstander)								Cost Per Product	=	$0.014
Market Comparable Annual Income					$37,472.76										Total Output	=	20743464.00
															Total revenue surrogate	=	$282,915.68
OJT Apportioning:																	
8 weeks @6 hours a day							Formal Schools:										
Data Acquisition		1 Week					2 Weeks (@ 8hours per day)										
Data Cleansing		.14 Weeks					Week = 5 days for formal training								Price Per Unit	=	0.01363879
Track Generation		.14 Weeks															
Track QA		2 Weeks					1 Formal training week added to Track Generation								Cost Per Year	$899,346.24	
							1 Formal training week added to Quality Assurance								Value Per Year	$14,711,615.34	
															PV Asset	($183,339,244.86)	
															PV .5 Asset	($91,669,622.43)	
															Cost	($11,207,842.01)	

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APPENDIX C. RADICAL TO-BE

Table 8. KVA Radical To-Be Data

MDA Threat ID Tracking Process (MIFC Atlantic)																		
Function		ALT			Percent IT		Total Learning		Times Fired		Number of	Cost/Employee	Total	Num.	Den.	ROK	ROI	
		(In Weeks)					Time		Per Week		Employees	Per Week	'Valuation					
							(In Weeks)				Per Day							
Data Acquisition	0.8	1	1.2	0.77	85.00%	89%	6.67	16800000	84000000	100800000	6	$720.63	560000000	$7,637,720.52	$4,323.78	176644.52%	176544.52%	
Data Cleansing	0.11	0.14	0.17	0.81	90.00%	95%	1.40	16800000	84000000	100800000	6	$720.63	117600000	$1,603,921.31	$4,323.78	37095.35%	36995.35%	
Track Generation	0.11	0.14	0.17	0.81	90.00%	95%	1.40	4200000	21000000	25200000	6	$720.63	29400000	$400,980.33	$4,323.78	9273.84%	9173.84%	
Track QA	1.6	2	2.4	0.18	20.00%	21%	2.50	4200000	21000000	25200000	6	$720.63	52500000	$716,036.30	$4,323.78	16560.42%	16460.42%	
							11.97		210000000			$2,882.52	759500000	$10,358,658.45	$17,295.12	239574.13%	239174.13%	
Assumptions																		
Work Year:					52 Weeks													
Work Week:					42 Hours										Actual Cost	$20,177.64 (per week)		
Watch:					12 Hours										Market Comp.	$33,149.98 (per week)		
OJT:					6 Hours per Watch													
Watchstander (E-5 w/8yrs) Annual Income					$28,825.20		(This is the "average" watchstander)								Cost Per Product =		$0.014	
Market Comparable Annual Income					$37,472.76										Total Output =		759500000.00	
															Total revenue surrogate =		$10,358,658.45	(per week)
OJT Apportioning:																		
8 weeks @ 6 hours a day							Formal Schools:											
Data Acquisition		1 Week					2 Weeks (@ 8hours per day)											
Data Cleansing		.14 Week					Week = 5 days for formal training								Price Per Unit =		0.013638787	
Track Generation		.14 Weeks													Volatility		0.375259609	
Track QA		2 Weeks					1 Formal training week added to Track Generation											
							1 Formal training week added to Quality Assurance											
		Assumption has been made that with full implementation of																
		tracks generated will be approximately 250,000 Tracks																

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