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Measuring the Value Added of Management: A Knowledge Value Added Approach

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Measuring the Value Added of Management: A Knowledge Value Added Approach

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Measuring the Value Added of Management: A Knowledge Value Added Approach

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Introduction

That management adds value to organizations is one of the unquestioned truisms of business, government, military, and any other multi-member organization. The question left largely unanswered is, "How much value does management add to an organization?" The central research focus of this study is to establish a method for objectively measuring the value management adds to an organization.

Determining the value added by management becomes particularly important as Navy acquisition managers deal with increasingly complex, open business models that engage many more participants in the development and implementation of products and services to support warfighters. There is a recognition that emerging, increasingly complex acquisition environments require more direction, collaboration, and control to achieve the reductions in costs as well as the increases in warfighting effectiveness that initiatives, such as the Open Architecture (OA) system acquisition and development framework, promise. The increasing burden on management in such environments largely derives from the amount of complexity managers must deal with by attempting to mitigate risks, improve predictions, and exercise the control and oversight necessary to be successful.

Determining the value added by management is important because:

- Managers need to know how well they are performing in more complex and demanding environments such as OA and open business models.
- Those who evaluate management performance need a common metric to gauge the degree to which managers are succeeding or failing.
- Poor performance by management threatens delivery time, acquisition costs, and capability of acquired products and services.
- A consistent and objective way to evaluate management provides historical performance data that leads to more precise risk estimates (instead of uncertainty-based guesses).
- Including management performance in the overall assessment of organizational performance provides a more complete picture of how well an organization is performing.

Objectivity Needed

Solving this problem requires a new and more objective approach to measuring the value added by management than previous efforts. Subjective approaches and approaches based on corporate-level residuals—which presumably are a result of management activity—will not provide the kinds of precision necessary to allocate value (e.g., revenue, outputs) to individual managers in proportion to the amount they contribute to the organization's value stream.

Management literature is replete with the characteristics, motivations, and general mantras regarding what it takes to develop and sustain great managers. There are even more articles, books, motivational tapes and videos on what it takes to become a great leader. Undoubtedly, these suggestions can lead to great management. However, without a way to partition the actual, countable contributions that management makes to the corporate bottom line or general organizational success, there will be no way to tell which suggestions really work and which add little or no marginal value.

Research Focus

This research will focus on making the case for a method to objectively measure the value added by management activities. We will review the general issues involved in developing a theoretically sound, rigorous, and pragmatic approach to estimating the value added by management. The paper will conclude with an example of how this approach would work in an open acquisitions environment.

Management "Dark Matter"

Dark matter, in the physics sense, is largely unobservable—albeit critical to understanding the physics of the universe. The dark matter of management has also been largely unobservable in the outputs of the core processes of an organization, although it is also critical to understanding the functioning of an organization.[1] These mysterious elements are the managing activities that guide the organization toward its future and are assumed to be associated with the market outcomes (e.g., increases or decreases in revenue, military capability) managers attempt to influence.

Management activities contribute directly to the outputs of the processes that are being managed, but they also involve 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 managers implicit knowledge accumulated over years of experience, training and education. We label this creative aspect as management "dark matter." This management "dark matter" has largely been assumed to be critical to the duties of a manager but has not been objectively measured as researchers attempted to account for the value added by management.

These heuristics from management's dark matter are not algorithmically definable and previously have been subsumed within the standard knowledge value added (KVA) methodology in gross estimates of the overall output of an organization at a given point in time. Basic KVA theory is designed specifically for all processes, activities that are algorithmically definable a priori, i.e., for processes with predetermined outputs (Housel & Kanevsky, 1995). KVA posits an analytic tautology that assumes that historical outputs of an organization at a given point in time can be described in common units and, therefore, can be counted in absolute terms. Further, the total revenue of a commercial organization is equivalent to the total number of common units of output at a given point in time. The theory must now be expanded to account for those managing activities that involve creative attempts to resolve risk, uncertainty and take advantage of upside potential.

To maintain the historical and analytic context of KVA, we will provide a way to count the management dark matter activities within estimates of the overall output of the organization at a given point in time. This is reasonable given the fact that previous dark matter activities can be found in current process outputs; they usually take the form of changes to those process descriptions that lead to new or changed outputs.

[1] Notionally, the grey (dark) matter of the brain also is where original thinking occurs.

For instance, in an open-business-model environment, if an acquisition manager suggests that a vendor change some aspect of his/her core processes to ensure that a project stay on schedule, and the vendor responds by changing his/her process to mitigate the perceived risk, then the acquisition manager's dark matter will eventually be manifested in the changed process. This example assumes that the acquisition manager and vendor are part of a virtual organization working collaboratively toward a final outcome, e.g., an integrated weapons system.

In the ARCI (Acoustic Rapid COTS Insertion) program, an open architecture (OA), open-acquisition business model was used to rapidly transition new technologies from the Advanced Submarine Technology Office (ASTO) housed within the Program Executive Office-Integrated Weapons Systems (PEO-IWS) and the ARCI program (housed within a different program office, i.e., PEO Subs). This created an increase in the complexity of the acquisition cycle. However, it also allowed the ARCI program to leverage the resources and outputs of the ASTO program when it created an inter-program partnership. The OA, open-business model provided the environment that created this opportunity as well as contributed to the increased complexity. In this environment, the ARCI acquisition management had to use more of its dark matter to ensure closer collaboration among the various parties as well as to predict and mitigate possible uncertainties and risks while leveraging the multiple resources of the "virtual" organization.

Accounting for the value added by acquisition managers, in this case, is more than just accounting for their routine process contributions; it also requires accounting for their use of dark matter capabilities to influence the future behavior of the virtual organization. If the acquisition manager is really "doing his/her job" in this open business environment, s/he will constantly be using this dark matter to attempt to control risks and uncertainties by predicting the future actions necessary to mitigate same.

This manager can no longer be content to simply ensure that the vendor meets the stipulated contract obligations. In the new open environment, the acquisitions manager must now coordinate with numerous potential contractors throughout the life cycle of the system acquisition. These must become a part of a virtual management team that collaborates regularly to ensure that the developing (or developed) system meets the needs of the warfighter. This new, more complex environment introduces greater opportunities for the manager to use his/her dark matter to creatively anticipate and solve problems while also seeking better ways to satisfy the constantly changing warfighter requirements.

Difficult-to-track Dark Matter Outputs

This dark matter aspect of his/her job has been more difficult to track in objective terms and largely has been relegated to anecdotal descriptions of the occasional successes and failures in the use of dark matter capabilities. These managers' job descriptions include directions to use their dark matter capabilities to control for risks, such as potentially slipping development and implementation schedules. However, it is often more easy for them to simply focus on the daily routines of "putting out fires" than to stretch their dark matter capacities to innovate when necessary to mitigate future risks and capitalize on future opportunities—in other words, to increase warfighting capabilities.

We can use standard KVA methodology to track the outputs of this dark matter activity over time since it has been assumed to be a part of the organization's overall output at a given point in time. As such, it is assumed to be a required part of the manager's

standard outputs and, thus, can be counted within the standard KVA methodology. However, we also assume that this dark matter output will have some influence on the marketplace. Therefore this output should correlate with changes in the market, such as increased sales.

Computing Metaphor

Another way to describe management dark matter conceptually is by using a computing metaphor as has been used previously to describe the KVA methodology (Kanevsky & Housel, 1998). Using a computing analogy, managers use their dark matter capabilities to *write the program* for the processes they manage. "*Writing*" the program includes:

- decisions they must make during the course of a given time period, including:
  - Deciding which "program" to use
  - Deciding how to allocate resources to produce given outputs
  - Sustaining activities that maintain his/her network
  - Forecasting the amount of outputs desired from the processes he/she manages
  - Creating, sending, and receiving messages
  - Selecting and using technology to support management activities

Writing the program is how managers create value in the processes they manage. The time it takes to write the program to produce a given output is the cost of managing. The actual, non-redundant length of the program is proportionate to the value of the program (Housel & Kanevsky, 1995). More complex dark matter decisions require longer programs, and simpler decisions require shorter programs. Writing a relatively long program that includes significant amounts of redundancy and does not execute or executes poorly is how managers increase costs—relative to managers who write shorter, i.e., more elegant, programs that produce the same outputs. This can be likened to the "art of good management."

Technology can support managers in producing their dark matter outputs. For example, in an open acquisitions environment, collaborative technology can support a manager in recording, distributing, and receiving messages. However, while "managing technology" may execute some routine management activities, there is no program, at this point, that can write its own unique program. This makes the position of the managers unique because, at this point in time,[2] it is their ability to create elegant programs that largely determines their success in managing.

[2] Ray Kurzweil (In the *Age of Spiritual Machines*) argues that computers will have the intelligence to write their own unique programs within the next 50 years.

The ability of a manager to write elegant programs that produce the desired amount and kinds of process outputs, largely determines his/her value added to the enterprise. If they write programs that predict poorly, managers will fail to allocate resources properly and, thus, fail to produce the desired outputs. This will be evidenced by overall lower returns on investment (ROIs) on given processes due to relatively poor utilization of process assets such as technology and employees.

Elegant, parsimonious, and precise management "programmers" will produce the best outcomes over time. This may be due to a variety of reasons, including: employees that are happier because they are more productive, the ability of management to respond quickly to changes in markets-environments, and higher utilization of technology assets based on more optimized process designs. There may be a variety of outcomes due to more elegant programs; however, regardless of outcome, elegant programs will result in higher ROIs in managing.

Dark Matter Correlates with Market Performance

We recognize that these dark matter activities are meant to influence the future behavior of the core processes of organizations to achieve the management goals established for the organization. As such, they should be correlated with the market performance of the organization in terms of the impact on outcomes obtained by organizations (e.g., increased capabilities, winning the battle, more revenue, or other forms of value).

The seeming conundrum is that while these dark matter activities are designed to influence future behavior and outcomes, historically, they can be accounted for at a given point in time. That they are part of the output of an organization at a given point in time is clear; however, they cannot be tied directly to the current outputs of the organization that produce the value or capabilities that markets are willing to purchase.

For example, in our new open business environment in which all parties are part of a collaborative virtual organization, an acquisition manager would feel free to suggest a potential risk mitigation strategy to a contractor because he/she assumes that the development schedule will slip due to the loss of a key programmer. With the required increase in collaboration among the contractor and the other parties involved in the development and deployment of a new integrated weapons system (IWS), precipitated by the use of an OA and open-business-model approach, managers of every group must engage in greater cooperation across organizational boundaries. To be successful, they all must use their collective dark matter capabilities to recognize and address potential risks and opportunities.

In this new cooperative environment, whether the acquisition manager's or the contractor's dark matter activity is directly responsible for changes to IWS development processes cannot be known unambiguously—e.g., "Was it the acquisition manager or the contractor manager that was responsible for the changed process that avoided the possible schedule slippage?" The only thing that is unambiguous is that both have produced the outputs from their collective dark matter capabilities, and these should be treated as coming from a single management entity. They should, therefore, be less inclined to point fingers when things go wrong due to poor use of management dark matter and more inclined to ensure that the IWS is delivered on time, with the capabilities required by the warfighter.

In addition, the cooperative use of dark matter to achieve common goals will ensure that managers make the adjustments necessary to seize opportunities to create greater capabilities in the IWS when deemed necessary by the warfighter. Tracking their collective use of dark matter makes it possible to assess the contributions of the new collaborative cross-organizational management team. There is nothing quite like being measured on overall performance to drive home the need for cooperation to achieve common goals.

Outputs of Dark Matter

If we assume that these dark matter outputs are a necessary part of the output of an organization—and this would appear to be the case in terms of our expectations for as least part of what managers should be doing: i.e., predicting the future and controlling for risk—then it follows that these dark matter activities of management are, a priori, designed to be part of the output of the organization. Indeed, a review of management job descriptions would include imperatives to "lead, motivate, plan for the future, control risks," all of which we are labeling dark matter activities.

For example, if a manager uses his/her creative insight to suggest that the product should be painted green as well as red, the painting process eventually must be changed to reflect the prediction that the new color for the product will sell better to a given segment of the market.

Or, for example, when an acquisition manager senses that the schedule is about to slip because a subcontractor has gone bankrupt, he/she must predict the effect of this risk and develop strategies to mitigate the problem, such as maintaining an option to purchase the service from another developer. Another example might be when the "manager" (officer) of a warfighting process that tracks ships in a congested area, such as the Persian Gulf, recognizes that something is amiss even though the track information appears to be correct. His intuition, based on the dark matter acquired over years of experience, comes into play in seeking further clarification of the track information because something (his intuition, or dark matter) tells him all is not well, and this ship may not be "friendly".

Operationalizing: The Measurement of Dark Matter

We assume that managers constantly acquire knowledge both formally and informally, learn from that knowledge, and incorporate that knowledge in their decision-making in predicting the future and in planning to control for risk and uncertainty from a constantly changing environment. This form of management "dark matter" output is manifested largely in the messages that managers generate, distribute and interpret to predict and control core processes to accomplish the goals of the organization. Most of a manager's time is spent in creating, sending, receiving and interpreting messages. These messages are basic descriptions of actions the manager is influencing his organization to take. Some of these actions are unambiguously tied to actual production of the process they are managing and, thus, are captured in the standard KVA methodology within the description of process outputs.

The central idea is that we can "see" the manifestation of that acquired knowledge and the subsequent managing activities via the networks that managers and information technology (e.g., collaborative technology) use to create, send, and receive messages.

These messages are sent to and received from the employees and the technology.[3] The actual contents of the messages take many forms and fill many purposes—all of which can be described in the common descriptive language provided by the KVA approach in terms of their relative complexity.

The challenge is to develop an operationalization of management dark matter outputs that permits an objective bifurcation of relevant and irrelevant activities without resorting to overly subjective interpretations and the potential biases such subjective judgments introduce. At the very least, the goal should be to establish an unambiguous principle for categorizing relevant and irrelevant activities that is defensible without resorting to subjective judgment. This bifurcation will be worked out as we attempt to operationalize this approach over time with actual case studies and empirical research.[4]

Those messages that are unambiguously tied to current process outputs represent routine management outputs that are measurable in the standard KVA methodology. Those management messages that are not found directly in current outputs of the process are evidence of management dark matter activity. Regardless of their semantic content, because we can observe all the messages and estimate their complexity, they represent a convenient way to observe and measure management dark matter outputs.

Management Dark Matter Outputs and Job Descriptions

Top executives often state goals in broad sweeping terms such as "We will move from product leadership to cost leadership within the next three years; We will move from a proprietary, closed business model to an open business model in acquisitions." Such broadly stated goals must be translated into action at the process level through changes in the process descriptions (e.g., make more widgets or make different kinds of widgets).

Management job descriptions should reflect the dark matter capabilities necessary to translate such broad, sweeping goals into operational realities. One way to measure dark matter output would be to examine the job descriptions of managers and ask them to estimate how many messages and/or activities they generate to fulfill each aspect of the job, as well as how often they do this within a given time period. To check the accuracy of

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[3] Future research may establish a more refined measure of dark matter activity and outputs by examining the networks managers create, modify and use to receive and distribute their messages. These networks vary in terms of their complexity; the messages sent and received also vary in complexity. These two forms of complexity can be described in terms of the knowledge required to reproduce them, and the knowledge can be described in common units using the KVA approach. With this information, we can measure the amount of knowledge transferred through each link in the network—including the knowledge used to maintain and modify the network.

[4] The basic problem is to determine what aspects of this management dark matter are relevant to organizational value and which are not directly relevant. It is possible to semantically interpret management activities as relevant or irrelevant to the organization. For example, when a manager arranges a dinner date with his/her spouse, it is very likely this activity was irrelevant to achieving organizational goals. However, when we examine less obvious examples, such as a manager musing about whether to invest in a new technology that may or may not ever be purchased, it is less obvious how this activity led to some organizational outcome.

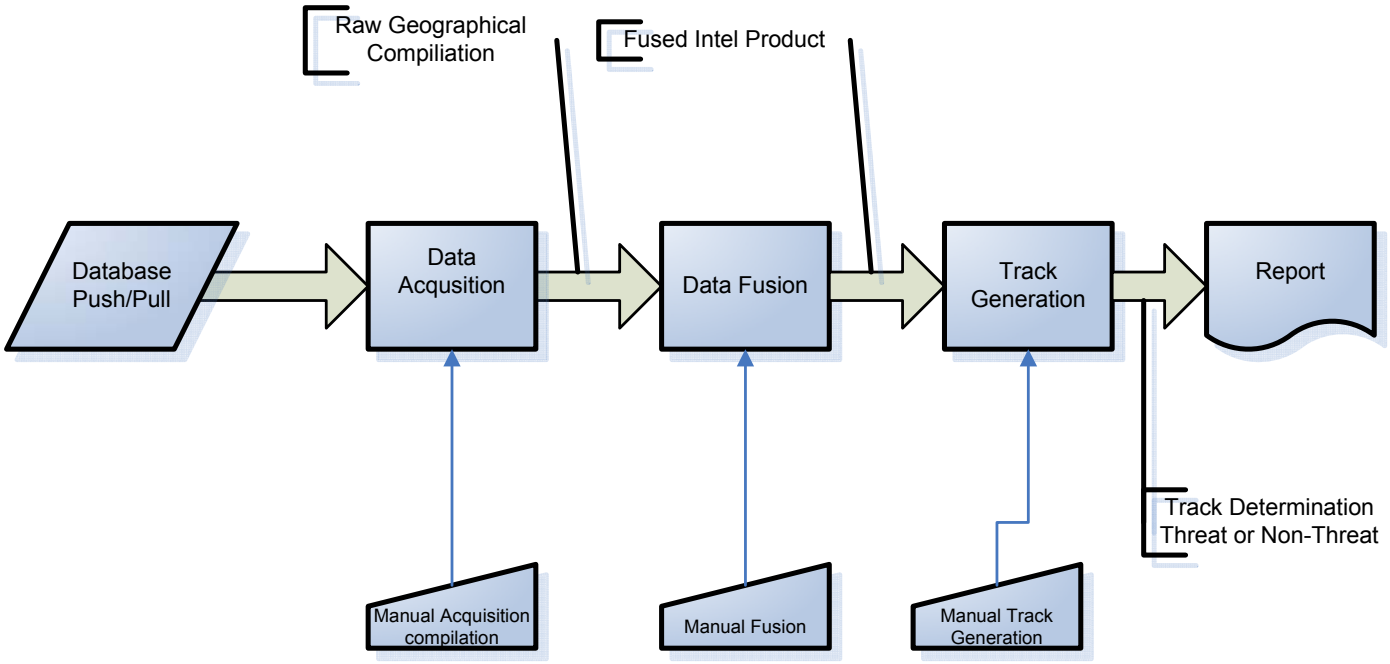
manager's self reports, we can check actual message logs, e-mails, other text-based historical records to ensure there is a high enough level of reliability among the estimates to proceed.

It would also be possible to ask them to generate a more precise job description if the original is not sufficiently reflective of what they really do. The next step would be to separate the duties that involve routine daily operations and those that are more reflective of management dark matter activities.

Case Example: Ship Tracking Process

There are approximately 250K ships at sea world-wide at any given point in time. The US military needs to know which are friendly and which are potential foes. The responsibility for tracking these ships currently rests with the Coast Guard. The tracking process must be managed by experienced Watch Commanders who can intuitively sense when a given track is incorrect (Figure 1). This ability cannot be automated at this point in time and is, therefore, indicative of dark matter. Watch Commanders must be able to anticipate when risks of false identification of tracks may be present.

Figure 1. Ship Tracking Process



Ship Tracking Management's Dark Matter Activities

The track manager and his watch commander must supervise the process to ensure that timely and accurate information is provided to various DoD entities to help them achieve situational awareness (SA). The primary job of management is to ensure its subordinates are correctly tracking the ship activity. One method by which members of management check tracking is the quality control step, in which managers must sign off on track reports as accurate.

In this environment, there are times when the managers intuitively recognize that the track information may not be correct—even though they may not be completely aware of why they have made such judgments. Their intuitions lead them to ask their subordinates to re-run the track information gathering to ensure its accuracy. Their use of dark matter results in communications/messages, to subordinates to rerun the tracking process on given suspect targets. As such, the communications are observable applications of their dark matter and can be described via the standard KVA methodology.

The times when intuitions are correct or incorrect also can be counted. If we take a conservative attribution strategy, we will only count the correct ones, those ships that turned out to be incorrectly tracked and categorized, as part of management's dark matter output. However, it can also be argued that to achieve a given yield rate for suspected tracks, management must have some level of false positives; therefore, all should be counted as management dark matter outputs. In either case, this simple case example enabled us to identify and count those dark matter outputs of management which in turn allowed us to allocate value to those activities.

In this case example, we have also demonstrated that when a simple dark matter capability can be explicitly described (i.e., we may uncover the heuristic decision-making process that managers used to identify the potential incorrect tracks), it becomes possible to capture this dark matter capability in intelligent computer programs such as expert systems. This is the basis for many expert systems that embed management dark matter decision capabilities within their code. The new tracking system developed by the Office of Naval Research not only automated most of the tracking process but also largely replaced the need for the managers to use their dark matter to identify potential incorrect tracks. The new system greatly improved the capabilities to track the enormous number of ships that previously were tracked primarily by human operators. It also is capable of gathering additional information that makes use of managers' intuition about possible inaccurate tracking largely unnecessary.

However, the track process designers continue to require the presence of management to sign off on the accuracy of tracks while ensuring that the routine tracking process is carried out as expected. If management becomes complacent about its dark matter duties, it may assume that the new system is so accurate that management members need not waste their time trying to find the potentially inaccurate tracks.

Because dark matter activities involve prediction, the possible removal of this management dark matter capability must be considered seriously because one correct prediction—i.e., identification of an inaccurate track by management that was not caught by the new system—might lead to identification of a suspect ship that is carrying weapons of mass destruction. Dismissing management prerogatives embedded in its dark matter

capabilities by "automating" them must be carefully considered before leadership eliminates this capability.

Standard KVA and Delta Correlation Approaches

The cascading of management goals to lower levels of management, and eventually to the process level, represents the relative influence of managers on their organizations. This kind of influence takes time to become a reality at the process level. Because the response of the market to these kinds of goal-setting messages is uncertain, it is necessary to measure the change or delta in value (e.g., capabilities, revenue) of the organization over time as the goals eventually become, or fail to become, reality in process changes.

We must acknowledge the likelihood that these kinds of unique management activities do indeed influence organizational outcomes—as has been argued in prior research as well as in general business publications about the role and value of leadership and management. This assumption leads us to propose that changes in these activities should be roughly correlated with changes in market outcomes.

Because making a causal, one-to-one connection between dark matter messages and changes in core processes is problematic due to the semantic-interpretation problems mentioned earlier, we will not attempt to causally connect the two. Because a pure historical causal relationship cannot be established between the dark matter-market outcome-process change deltas, we will need to track the correlation among the three over time to better understand the relationship between deltas in management dark matter activity and the presumed corresponding deltas in market responses.

This logic leads to two measures of management dark matter activity. First, we can track the deltas in management's dark matter activity, process changes, and market outcomes over time. Second, using standard KVA methodology, we can account for the amount of dark matter outputs as a percentage of the total outputs of a process and, consequently, of the organization at a given historical point in time.[5]

As a first cut, we can aggregate the delta of all managers' dark matter activity and correlate it with market outcome deltas. Individual manager dark matter output deltas can be compared within the organization and correlated with the market outcome deltas to infer which managers have had the most influence on market outcomes. This approach extends standard KVA theory to the largely uncharted realm of how management influences organizational outcomes.

Basic Hypothesis

This formulation of the problem enables us to test some basic hypotheses about the correlation among dark matter outputs and organizational outcomes. One hypothesis would be that there should be a much higher percentage of dark matter outputs in an open

[5] In the first case, we can use standard KVA methodology to allocate outputs and associated value (e.g., revenue, capability) to individual managers at a given point in time. In the second case, we can measure the relative changes in deltas among the managers' dark matter activity and the corresponding changes in market deltas.

business environment (in which the OA approach is used to develop IWS systems) compared to a closed business model approach (in which proprietary IWS systems are developed).

Similarly, in the corporate sector, the amount of management dark matter produced over a given period of time should correlate with the amount of revenue generated over a period of time. It should follow that mature industries (e.g., petroleum extraction) that have largely mitigated risks and operate within a relatively stable environment in which demand is largely predictable should have less of this kind of dark matter than those operating within largely unstable environments (e.g., biotechnology).

The same would pertain to military environments in which there have been periods of stable competition (e.g., Cold War) among nations compared to periods when competition among entities is ill-defined and highly volatile (e.g., Global War on Terror). In the current, military environment in which there is greater instability, there is a larger need for the production of management dark matter to predict and deal with uncertainties and risks.

Hypothesis Test: ARCI versus Proprietary Acquisition

The ARCI case example provides a simplistic test of this hypothesis. We can compare the rough orders of magnitude estimates of dark matter outputs in both proprietary and open environments and then correlate these with the outcomes for development of IWS systems in both environments.[6] The hypothesis is that the OA, open-business-model environment of ARCI generated significantly more dark matter output than the proprietary model of system acquisition in IWS.

The hypothesis rests on the basic assumption that when managers are successful in setting and implementing goals to affect the markets within which they operate, markets respond positively and the converse is also true.

Through changes that they induce in their organization's core processes, the commercial market responds by purchasing more of their products, the same number of higher priced products, or both outcomes. In the military "markets," managers/officers use their dark matter to anticipate future actions by adversaries by adding capabilities and improving system acquisition cycle-times to respond to new events and competitor's strategies.

However, when managers increase these kinds of creative activities and the result is lower revenue or reduced capabilities, it can be said that management reduced or failed to increase value. The delta in dark matter management activities from one period to the next, in response to anticipated changes in the market, should correlate to organizational performance over time.

[6] It does not permit, however, the translation of deltas in dark matter activity over time into absolute numbers against which value can be allocated.

It does not follow, however, that merely increasing the number of dark matter activities (e.g., setting goals, trying to implement an increased number of goals) will result in increases in value. These goals and other creative management activities must eventually be translated into operational changes in core processes to affect any changes in company outputs and, therefore, responses to changes in the market. Such inevitability provides a rationale for counting management dark matter activities within counts of the total output of an organization at any given point in time.[7] Clearly, these activities are present and can be described with the standard KVA approach currently used to describe the outputs of all processes in common units. It follows that the standard KVA approach may be extended to triangulate with the correlational approach in estimating the effect of dark matter outputs on organizational outcomes.

ROI on Management Dark Matter

Using the KVA knowledge metaphor to describe outputs, the absolute total contribution of managing a process is equivalent to the total amount of knowledge required to produce and interpret all management messages during a given time period. The amount of time a manager (and supporting management technology) spends using this knowledge is the cost of management. It follows that a manager who must use a large amount of knowledge to process messages but can process those messages quickly, provides a relatively good return on investment in managing. Those who take longer to produce a similarly complex output cost more and provide a lower relative return on investment.

We would need to make a further separation of messages that involve use of dark matter from those that do not. Following this separation, we would estimate the amount of complexity in each message set using the learning time or other KVA approach, and estimate the total amount of output from the dark matter activity (i.e., the prediction-based messages). This resulting value would be included in the total output for a given period, and value would be allocated proportionately as is done currently in the KVA method for normal process outputs.

We can use standard KVA methodology to allocate outputs and associated value (e.g., revenue, capability) to individual managers at a given point in time.

Resolving uncertainty requires that managers make a prediction about what demands the future will make on current processes in terms of the amount and kinds of outputs required from those processes. These messages, interpretations of messages, and decisions about resolving risk and uncertainty can be observed over time such that it is

[7] A very crude and simple test of this hypothesis would be to compare the dark matter job activities of the acquiring manager in a proprietary environment with the dark matter job activities of managers in an OA, open-management environment. The number of messages and complexity of messages used to coordinate acquisition in an OA, open-business-models environment would be much greater than for managers in the proprietary, single-vendor context. This would assume that the processes managed have about the same level of complexity. Relative complexity of the process becomes the index against which the amount of dark matter per unit of complexity is produced.

possible to gather historical data on the number and amount of complexity of these dark matter managing activities.[8]

So, in addition to the routine KVA data that estimates the number of common units of output from algorithmically definable processes, it also is possible to count the number of dark matter outputs and their respective complexity. The total amount of output, then, is a function of the number of times a given asset produces algorithmically defined outputs multiplied times the amount of complexity required to produce the outputs plus the dark matter outputs that occur in that given time period.[9]

Past research on the value of management and leadership provides a useful review of alternative approaches to this daunting problem. There are a number of lines of research that have attempted to address this problem indirectly and may offer some insights about its many varied aspects. Thus, it would be useful to review the strengths and weaknesses of these prior attempts to resolve this difficult problem.

Prior Approaches to Assessing the Value of Management

The literature on the value added by managing includes the effect of corporate governance on firm value, the drivers of value (including managing activities), the characteristics of great leaders, failures of management, and fund management.

This review of previous attempts to assess the value that management adds includes research on:

- How corporate governance affects a firm's valuation,
- What management characteristics can lead to improved company value,
- Fund-management approaches to solving the problem, and
- Attempts to solve the management value added quantification problem using a knowledge framework.

Corporate Management/Governance Value

The current literature discussing the effect of corporate governance on management valuation does not focus on direct valuation of individual managers or those in positions to perform management governance activities. Instead, the current literature revolves around

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[8] This formulation assumes that we do not count redundancy in the dark matter activities—such as exhorting the vendor to "work harder" every day during the observational time period. We would count the non-redundant or unique dark matter outputs. In this case, we might only count the exhortation to work harder as one output instead of one output repeated many times. We would also separate out the non-relevant activities—for example, when the manager calls his wife to arrange a dinner date.

[9] Given that there are many, if not infinite, alternative paths for the organization's future, it is impossible to enumerate all the potential opportunities foregone by selecting a specific path. It is, therefore, not useful (in accounting for dark matter outputs) to attempt to look backward to determine whether managers might have better utilized their dark matter to make "better" predictions. This type of interpretation must be left to the subjective judgment of the leadership of the organization.

two major themes: an analysis of corporate governance and its relation to firm value as well as an analysis of corporate management techniques and suggestions on qualitatively increasing management's value.

Literature focused on corporate governance/management focuses on two major themes: addressing whether corporate governance affects firm value and providing suggestions on how to qualitatively increase the value of corporate governance/management—thus, increasing firm value. Literature focused on the second theme generally does not relate techniques directly to quantitatively measured increases in firm value, but instead implies that the techniques will increase value in some way.

Corporate Governance and its Effect on Firm Value

Black, Jang, and Kim set out to answer the question: "How do a country's corporate governance rules, or the corporate governance practices of individual firms within a country, affect overall firm value and performance?" (Black, Jang, & Kim, 2003, p. 1). This study answers the question by developing a corporate governance index for 526 Korean public companies. 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. It then uses multiple regression equations to explain the variance in the corporate governance index compared to firm value. The analysis finds evidence that corporate governance is an important factor in explaining the market value of Korean public companies. Following a similar model Beiner, Drobetz, Schmid, and Zimmerman (2006) establish a relationship between corporate governance quality and firm value.

Beiner, Drobetz, Schmid, and Zimmerman, in their work "An Integrated Framework of Corporate Governance and Firm Valuation," state that:

> Recent empirical research shows evidence of a positive relationship between the quality of firm-specific corporate governance and firm valuation. Instead of looking at one single corporate governance mechanism in isolation, [this report] constructs a broad corporate governance index and [applies] five additional variables related to ownership structure, board characteristics, and leverage to provide a comprehensive description of firm-level corporate governance for a representative sample of Swiss firms. To control for potential endogeneity of these six governance mechanisms, [the report develops] a system of simultaneous equations and [applies] three-stage least squares (3SLS). [The] results support the widespread hypothesis of a positive relationship between corporate governance and firm valuation. (2006, publication abstract)

This work shows a relationship between the quality of specific corporate governance practices and the value of a firm, but does not allow for direct valuation of individual managers. It primarily supplements the intuitive hypothesis that quality affects value.

Klein, Shapiro, and Young (2005) prove a similar relationship between quality and value in Canadian firms, but add the additional element of the ownership category. In their report, the researchers analyze the relationship between firm value and indices of effective corporate governance in Canadian firms. "The results indicate that corporate governance does matter in Canada. However, not all elements of measured governance are important,

and the effects of governance do differ by ownership category" (Klein, Shapiro, & Young, 2005, publication abstract). The results of this study establish the link between quality of governance and value.

An additional work with similar results is Hsiu-I Ting's (2006). In this work, Ting investigates the 207 IPO companies encompassing the Taiwan Security Exchange between the years 1992-2002. His analysis examines situations in which corporate governance could increase firm value.

> [Ting] finds positive effects of corporate governance on firm performance, which proves the existence of a corporate governance effect. Different from the previous studies, this paper addresses the fact that the corporate governance effect exists under poor economic conditions. As expected, firms with poor corporate governance mechanisms tend to perform badly when business cycles go downward. In other words, the report indicates the importance of corporate governance increases during poor economic conditions. Firms with higher agency costs also show a significant corporate governance effect. [Also, when investing more in other companies causes a firm structure to become more complicated while simultaneously diminishing information disclosure, the corporate governance mechanism could work effectively.] Finally, the recognition of a supervisor is an important factor for corporate governance effect as well. Firms with executive recognition appear to have a corporate governance effect. (2006, p. 8)

To summarize, this line of research demonstrated that there is a relationship between corporate governance firm values, but there is a profound gap in quantifying the precise value of the management that governs companies. Furthermore, once the management/government structure is broken down and one wishes to determine the value of specific managers, the lack of quantifiable value studies becomes even more accentuated. There is a lack of studies that attempt to measure the value of management in dollar terms.

Another theme of corporate management valuation studies involves discussing the methods of increasing the value of corporate management. Unfortunately for our purposes, this literature fails to produce objective measures of how much value managers add.

Increasing the Value of Corporate Management

There are many works discussing techniques to improve management techniques, and most offer useful insights to do so. However, these techniques are limited because there is no quantifiable measure to discover how they increase firm value.

All agree that more effective management is ideal, but seem to question how one can discover what management characteristics and techniques are the most effective without discovering the relative value they add. How can managers discover what they should place emphasis on without knowing the payoff? The following works all discuss valuable techniques crucial to manager success, but none supplement their advice with techniques to discover their actual value added.

In their book, *Value Driven Management: How to Create and Maximize Value over Time for Organizational Success,* Pohlman and Gardiner discuss how to increase

management's value by focusing on eight "value drivers": external cultural values, internal cultural values, employee values, supplier values, customer values, third-party values, competitor values, and owner values. This guideline is structured to help managers keep pace with fluctuating business structures in order to achieve long-term success. Pohlman and Gardiner's book is about leading, managing and working in organizations as managers enter the twenty-first century. Its techniques are rooted in traditional theories and styles, but focus on value creation over time—because traditional theories must constantly make adjustments as paradigms shift.

Following in the same spirit is Michael Armstrong's *A Handbook of Management Techniques Revised*, 3rd edition. Armstrong's work acts as a guide for professional managers or as an essential guide for students. His work attempts to encompass value-adding skills/techniques for numerous management responsibilities. It distinguishes between tasks that fall into the following categories: marketing management, operational management, financial management, human resource management, management science, planning and resource allocation, efficiency and effectiveness. Within these topics, Armstrong's work includes 100 qualitative, systematic, and analytical methods used to assist in decision-making and to improve efficiency and effectiveness. As is evident, Pohlman and Gardiner as well as Armstrong focus on techniques that increase management's value. Gardner's work described below takes a slight shift in topic from suggesting useful techniques to highlighting character traits that are inherent in a successful leader.

John Gardner's *On Leadership* (1990) focuses on the characteristics a leader should possess, centering on managers and how such qualities increase their value to their business. Gardner lists six respects with which leader/managers distinguish themselves from the general run of managers:

- They think longer-term—beyond the day's crises, beyond the quarterly report, beyond the horizon.
- In thinking about the unit they are heading, they grasp its relationship to larger realities—the larger organization of which they are a part, conditions external to the organization, global trends.
- They reach and influence constituents beyond their jurisdictions, beyond boundaries.
- They put heavy emphasis on the intangibles of vision, values, and motivation and understand intuitively the nonrational and unconscious elements in leader-constituent interaction.
- They have the political skill to cope with the conflicting requirements of multiple constituencies.
- They think in terms of renewal. The routine manager tends to accept organizational structure and process as it exists. The leader or leader/manager seeks the revisions of process and structure required by ever-changing reality.

Management characteristics are obviously important to company success. Therefore, it clearly follows that company failure can result from choosing a manager that lacks the characteristics necessary for success. Gerard Egan, in *Adding Value: A Systematic Guide to Business-driven Management and Leadership*, cites this as one of the

main reasons for organizational failure. He provides information on choosing the correct manager.

When companies fail, Egan proposes that true failure lies not with managers themselves, but with the system by which they are chosen and developed. Egan states that it is not wise to promote professionals to management without any guidance on how to actually manage; they may excel in a specific skills area, such as engineering or accounting, but may lack the specific management training necessary to be good managers. Egan describes the basic skills managers need to look beyond their own area of expertise in ways that add value to the business. He presents a comprehensive, integrated system of management that can be adapted to meet any company's real business needs—including strategy, leadership, structure, human resources, innovation, and organizational culture. Egan offers theoretical constructs as well as three practical, hands-on models. Most importantly, he shows how to integrate the models into a system that managers can use to identify, organize, and implement the best ideas emerging from today's "business and organizational potential" movement.

All the techniques on management characteristics discussed in countless books may be useful, but they do not address the issue of how much value such techniques and characteristics can add in specific instances with specific managers.

The Alpha measure in fund management attempts to grasp some idea of the value of management in general, but also has several limitations that make it problematic for use in determining the value added of individual managers.

Lessons from Fund Management Research

“Alpha” measures the difference between a fund's actual returns and its expected performance given its level of risk (as measured by “beta”). A positive alpha figure indicates the fund has performed better than its beta (risk) would predict. In contrast, a negative alpha indicates a fund has underperformed, given the expectations established by the fund's beta. Some investors see alpha as a measurement of the value added or subtracted by a fund's manager. There are limitations to alpha's ability to accurately depict a manager's added or subtracted value. In some cases, a negative alpha can result from the expenses that are present in the fund figures but are not present in the figures of the comparison index. In addition, alpha is dependent on the accuracy of beta: If the investor accepts beta as a conclusive definition of risk, a positive alpha would be a conclusive indicator of good fund performance. Of course, the value of beta is dependent on R-squared.

For Alpha vs. the Standard Index, Morningstar performs its calculations using the S&P 500 as the benchmark index for equity funds and the Lehman Brothers Aggregate as the benchmark index for bond funds. Morningstar deducts the current return of the 90-day T-bill from the total return of both the fund and the benchmark index. The difference is called the fund's excess return. The exact mathematical definition of alpha that Morningstar uses is listed below.

Alpha = Excess Return - ((Beta x (Benchmark - Treasury))

Benchmark = Total Return of Benchmark Index

Treasury = Return on Three-month Treasury Bill (Morningstar).

Aside from Alpha, there have been several previous attempts to quantify the contributions of management, but they have, as yet, failed to provide a means to quantify the actual value added by individual managers. More recent approaches have employed a knowledge-based metaphor to frame the problem.

Knowledge-based Approaches

Housel and Nelson (2005) attempted to quantify the contributions of management in aggregate using a knowledge-based framework. The general idea of their study was that by quantifying management's total accumulated education, experience, and time with a firm, it was possible to generate its weighting on the output of a firm.

The limitations of this approach were that it did not provide a means to quantify individual managers' contributions; it assumed that management's aggregated contributions were purely a result of its members' combined education, experience, and time with the firm, and such weightings were applied as a constant across core areas or processes of a firm. While useful as a first attempt to quantify the value added by management in aggregate, the general approach assumed away individual differences among managers in terms of the value they add to a firm; likewise, the weighting factor could not be directly tied to the outputs of a firm in a relatively unambiguous way.

Further, it would be quite possible for two firms to have nearly the same weighting factor for management with radically different profitability and productivity scores. A more precise methodology that can differentiate among individual managers based on their observable contributions to process outputs would resolve these problems.

Pavlou, Housel, Rodgers, and Jansen's (2005) research had implications for the potential value added by managing activities. They assumed that implicit knowledge, which is akin to the notion of the type of knowledge managers use in making creative decisions (i.e., dark matter outputs), could be accounted for in terms of the experience of employees (including line managers). As such, a simple algorithm to measure their years of experience would serve as an indicator of the amount of knowledge used to produce the outputs of creative problem solving. However, this study did not directly address the issue of the value added directly by creative managing (i.e., management dark matter) activities.

There is a substantial collection of literature regarding corporate governance, leadership characteristics, and fund management, among other things, which attempts to address directly or indirectly the issue of how to measure the value added by managing activities. Yet, there remains a lack of research that attempts to objectively quantify the value added by individual managers. Further, past approaches do not provide a way of structuring the problem such that this kind of objective measure can be derived and revenue or value can be allocated to individual manager's dark matter outputs.

This research gap is further accentuated by the current concerns over the transparency of corporate activity, which assists investors in making more informed decisions. Transparency would aid investors in understanding the rationale for compensation packages provided corporate executives. This call for transparency is particularly important for businesses in the United States, but likely applies to the rest of the business world as well.

The research reviewed leads to a common conclusion: firm governance, leadership characteristics, management knowledge and experience do affect firm valuation. Because firm valuation is ultimately a result of a firm's profitability or productivity over time, there is a direct relationship between firm valuation and profitability or productivity over time. The question remaining is, "How much do dark matter managing activities affect firm profitability?"

The prior research also provides qualitative recommendations for how individual managers can increase their potential value to the firm. However, there is no relatively objective quantifiable evidence available to tie given characteristics of great leaders directly to the actual profitability or productivity of a firm.

While promising, the Alpha measure (the term sometimes used as the measurement of value a manager contributes to a fund), is a theoretical measure, is difficult to estimate, and is seldom reliable because it is very difficult to operationalize. Given that there does not appear to be a relatively objective way to quantify the value added by individual managers, such a measure would be beneficial to both managers and investors alike.

An approach to estimating how much value managers add to an organization or fund would provide the kinds of performance data that might be used to reward value-adding managers while not rewarding those that perform poorly. This presumably happens today with existing performance-evaluation techniques. But often, these techniques appear very subjective. A more objective technique that ties performance directly to the firm's profitability/productivity, indicating how much of a firm's revenue can be allocated to given managers' activities, would provide a more convincing evaluation.

The same performance information might lead poorly performing managers to self-organize in a way that ensures they are in positions where their talents can be used in the most profitable, productive ways. Such measurement would also provide investors with the kind of performance data that would lead them to reward organizations in which value added by management benchmarks well within an industry segment while withdrawing support for firms in which management does not perform well.

The same phenomena should occur in non-profit organizations as well when relative productivity among organizations can be compared on an objective basis. The federal government with its stop-light (Red=poor performance, Yellow=needs-improvement performance, and Green=good performance) scorecard for the large federal agencies is attempting to accomplish this goal. However, these rather crude indicators do not allow for the objective quantification of agency productivity, let alone the performance of agency management.

What is needed is a method that provides a way to quantify individual managers' contributions using structural, analytic, and relatively objective techniques that would allow comparisons among organizations. The method we proposed above promises to meet these criteria and will allow allocation of revenue to managing activities. This extension of the KVA framework allows the description of managing activities in common units. In addition, because managers produce, interpret and send messages through their networks, the method also accounts for these managing activities in a common descriptive language.

Options and Dark Matter

Many management decisions are constrained by legal or regulatory frameworks that severely reduce or virtually eliminate management's ability to examine alternative future pathways or options. If there are no options for managers to generate and from which to select, there is no purpose for dark matter activities.

However, where options exist, managers can take full advantage of their dark matter capabilities to help move the organization toward desired future states. The introduction of open business acquisition models using an OA system development framework promise to create more options for managers to achieve their objectives. To succeed in this new environment, managers will have to make more use of their dark matter to produce the kinds of outputs that truly serve their warfighting customers. Acquisition managers should be more free and motivated to use their dark matter capabilities to mitigate potential risks while taking advantage of upside opportunities to build better systems that will meet warfighters' changing requirements as they face a more uncertain environment.

On the other hand, if acquisition managers follow management practices that lead to proprietary, non-collaborative solutions, their number of options (and, thus, the requirement for the use of their dark matter) are reduced. This, in turn, could lead to a reduction in warfighting capability compared to situations in which OA and open business models are employed, in which management dark matter can be more easily utilized by acquisitions management.

Framing these options using the real options analysis method is one way to structure managers analysis that also takes advantage of KVA data. This technique has the potential to provide managers a way to achieve more consistent results or organizational outcomes over time. Such techniques as real options and KVA can support managers in producing more informed dark matter outputs that will lead to better outcomes over time.

Benefits of Measuring the Value Added of Management

This method for measuring the performance of managing activities provides a variety of new kinds of information for executives, investors, and managers. These include:

- a method to test the value of different management techniques (including those advocated in prior research)
- information that investors could use to determine the performance of managers
- new ways to determine a salary or reward system based on managers' verifiable contributions
- a basic return on management (ROM) measure at any level of aggregation in an organization
- performance feedback to motivate managers to best utilize their individual talents/strengths

This new information would allow Adam Smith's *invisible hand* of the competitive market place to manifest itself in determining manager rewards and would allow managers to concentrate on techniques that are proven to increase their value.

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Appendix A. Future Research—The Delta Problem

The ultimate goal of the approach is to allocate some amount revenue to amount of management dark matter of outputs. This will become more likely when we have the derivative (coefficient) necessary to convert the dark matter correlational deltas to absolute numbers. The delta will be proportional to revenue with a given coefficient (that is yet to be discovered), once the coefficient is established.

Example of the problem:

Al Smith, manager of X process, generated 1Gigabyte of (relevant) dark matter based messages during January. In February, he generated 2 Gigabytes of dark matter messages. In March, he generated .5 Gigabytes of dark messages. In January, the company made $100 in revenue, in February it made $400 in revenue, and in March it made $200 in revenue. Correlating Al's amount of dark matter messages per month with revenue per month we establish a relatively negative correlation between the two values. We can then check the volatility of the company's revenue performance and Al's dark matter messages over the same 3 months and correlate these volatilities. Now we have 2 correlations: between revenue and Al's amount of dark matter messages and between volatility of revenue and volatility of Al's amount of messages per month. The correlation coefficient between the two would allow us to eliminate the dark messages that are not related to the revenue. We would then be able to predict the manager's activities based on changes in revenue or vice versa.

We need to establish the percentage of relevant (i.e., dark matter based) to irrelevant manager messages for every time period in terms of dark matter outputs. The volume of irrelevant messages should be independent of the prior time period. The amount of irrelevant messages is independent from revenue; the correlation of relevant messages to revenue should be very high when a manager is influencing corporate outcomes. The correlation between relevant and irrelevant messages also should be very low.

These basic conditions can be tested in empirical research. The results of the research should help us establish the coefficient that will allow us to translate correlational deltas into absolute numbers so that revenue can then be allocated to dark matter outputs.

Appendix B. Correlating the Delta in Value and Management Dark Matter Activity

Once the problems of establishing a method of bifurcating relevant and irrelevant dark matter messages has been resolved, it will be necessary to provide the method for relating changes in dark matter activity with changes in value (e.g., revenue, capability). To do this, we would have to establish a baseline dark matter measure for each manager against which to calculate the rolling averages to generate the delta estimates. The corresponding time periods deltas would also be calculated to enable the correlations. Over time with a large sample size, it will be possible to estimate the optimal number of dark matter messages for a given level of environmental, market uncertainty.

Assumptions and Algorithms

In what follows, we lay out the basic algorithmic framework and assumptions for estimating the correlation between the management dark matter delta and value (e.g., revenue, capability) delta.[10] This approach will assume a conservative semantic interpretation that would permit estimation of amount of dark matter outputs in common units. The following algorithms are a preliminary attempt to describe the delta correlation approach.

The basic equation that accounts for all of the outputs of an organization at a given point in time is:

N (i.e., number of firings of a process, activity) x A (i.e., amount of complexity for one firing) + M (i.e., relevant dark matter management activity). Stated more simply:

N x A + M = Total Value (T)

To measure the change in this equation from time period 1 to time 2, it is possible to compute the total value produced in T_1 and subtract that from the total outputs in T_2 in the following equation:

Total value time period (T_1) = $N^1 \times A^1 + M^1$

Total value time period (T_2) = $N^2 \times A^2 + M^2$

The delta for value over the two time periods can be stated as:

$(N_1 - N_2) \times A + (M_1 - M_2)$ = delta in value resulting from dark management activities.

$\frac{N^2 - N^1}{A^1}$ $(N^2 - N^1) \times A + (N^2 - N^1)$ corresponds to $\rightarrow$ $\frac{R^2 - R^1}{N^2 - N^1}$

$\frac{(M_4 - M_3)}{A + (N_4 - N_3)} \rightarrow \frac{(R_4 - R_3)}{(N_4 - N_3)}$

$\frac{M - M^3}{N - N^3} \_\_\_ \frac{M^2 - M^1}{N^2 - N^1} \rightarrow \frac{(R - R^3)}{(N - N^3)} \_\_ \frac{R^2 - R^1}{N^2 - N^1}$

The degree of change from one period to the next resulting from this dark management activity should correspond to the change in value (e.g., revenue, capability) from the same two time periods. This equation can be stated as follows (where V = revenue or capability):

$A_1 (N_2 - N_1) / (N_1 - N_2) \times A + (M_2 - M_1) / (N_2 - N_1) \rightarrow (V_2 - V_1) / (N_1 - N_2)$

The above formulation assumes that we have separated out irrelevant messages from M and that M represents relevant messages. It also assumes that management messages that can be found in the outputs of current processes are algorithmically definable and, therefore, accounted for using the routine KVA methodology. This formulation

[10] The approach is incomplete at this juncture because we do not have the coefficient that would allow us to derive an absolute number (i.e., in common units of output) that would lead to allocation of value to management dark matter activity.

assumes that redundant messages have been eliminated to prevent over-estimation of M. This formulation also assumes that it is possible to derive all estimates from historical data.

Appendix C. Observations about Over-estimates of Dark Matter

Our formulation of the effect of management dark matter activities on organizational value can lead to some interesting observations about managers who generate dark matter activities that may not contribute to organization value. For example, when the change in value is 0, the corresponding change in M should also be 0. Managers whose generation of dark matter messages do not correlate with organizational performance may be creating a lot of "churn" but little value. Given a large number of time periods, the manager whose dark matter messages do not correlate with organizational performance would be seen as one who was not providing unique management contributions that had an impact on organization's value-generating capabilities.

This formulation does not reward redundancy in management dark matter messages. For example, the manager who issues the command, "Work Harder!" everyday for a given time period would only get credit for one message because the following "Work Harder!" messages would be redundant with the first. Only new and unique messages would be counted in the total M for this given manager.

This formulation also would lead to the conclusion that management dark matter would have little influence on organizational value generation when the organization was operating in a very stable environment with little risk or uncertainty. There should be a corresponding increase in management dark matter activity when an organization encounters turbulence, risk, and even higher opportunities for increased value. It follows that the complexity of a management environment increases in correspondence with increases in environmental uncertainty or risk, and the amount of dark matter messages should also increase correspondingly in response. For example, instructing an employee to "paint the door green" in routine operations is much less complex than trying to predict how the market will respond to green doors as tastes change. Similarly in the military environment, an officer's instructions to move supplies from point A to point B in peace-time would be less complex than in war-time, when there are increasing risks and uncertainties that must be dealt with.

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- PBL (4)

- Contractors Supporting Military Operations
- RFID (4)
- Strategic Sourcing
- ASDS Product Support Analysis
- Analysis of LAV Depot Maintenance
- Diffusion/Variability on Vendor Performance Evaluation
- Optimizing CIWS Lifecycle Support (LCS)

Program Management

- Building Collaborative Capacity
- Knowledge, Responsibilities and Decision Rights in MDAPs
- KVA Applied to Aegis and SSDS
- Business Process Reengineering (BPR) for LCS Mission Module Acquisition
- Terminating Your Own Program
- Collaborative IT Tools Leveraging Competence

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