Knowledge is Power

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ABSTRACT

From LCpl to LtGen and contractor to CEO, decisions are made based on information - not data. Yet, our Information Technology (IT) systems focus on the big "T" with a small "i". Turning the raw material of data into information (never mind insight) requires large investments in human capital, with specialized analytical skill sets, that produce multiple versions of the truth. These analyses are based on incomplete, rearward-looking information that does not target the entire value creation chain (Factory to Flight line). The result is episodic, inefficient organizational learning and sub-optimal return on investments. The following paper addresses PMA-275's strategy map development and the decomposition of information capital requirements. The goal is to turn data into information for people to make decisions that lead to actions that add/create value. Information capital requirements consist of two main parts: information infrastructure and information capital applications. Informational applications range from transactional requirements that automate the correlation of data from disparate data systems, to knowledge management/business intelligence tools that discover new patterns in the data to develop new business rules.

INTRODUCTION

The 1997 Quadrennial Defense Review (QDR)[i1] reduced the V-22 program objective from 425 aircraft to 360. The decision was based on the MV-22's increased capability, reliability and maintainability. Supporting these claims were the demonstrated capability of the aircraft through test and the expected benefits of information systems, both on and off aircraft[2]. In 2002, OSD directed a Defense Planning Guidance (DPG) study to review the V-22 program. The Services' reaffirmed the expected benefits based on maintenance, logistic and informational systems concepts.

These benefits have not been realized due to inconsistent alignment between the vision, technology and program development. In some cases, we have purchased the mine (infrastructure) but have not invested in the tools to extract the gold.

To maximize the benefits of the aircraft and supporting information technology, PMA-275 developed a top down strategy using the Balanced Score Card[ii]. This approach was critical in identifying the relationship and requirements for information capital in context of the Program's strategic goals.

Balanced Scorecard

PMA-275 has used the Balanced Scorecard (BSC) to assist with strategic planning and program alignment. The BSC is an industry standard approach used by 70% of Fortune 500 companies. One of the benefits of the BSC is the ability to establish cause and effect relationships from strategy to execution while providing line-of-sight between the individual worker and the overall program strategy. The BSC compliments the Naval Aviation Enterprise's AIRS*peed* initiative and a culture of continuous improvement.

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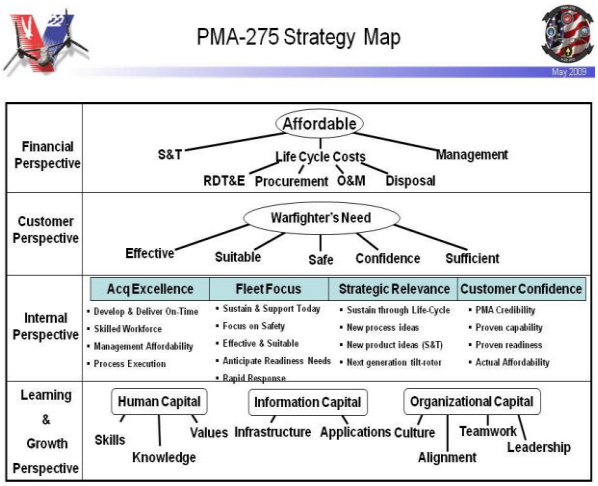
[1]Presented at the American Helicopter Society 67th Annual Forum, Virginia Beach, VA, May 3-5, 2011.

[2] Same year that NAVAIR's Automated Maintenance Environment (AME) was instituted.

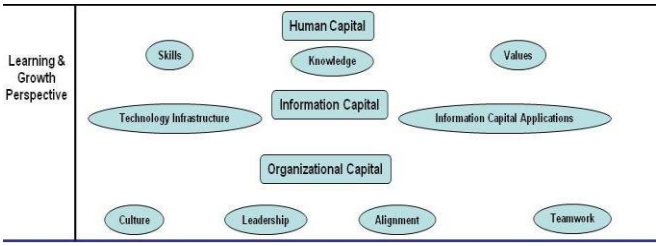
Strategy Map[iii]

The BSC uses four perspectives, Financial, Customer, Operational, and Learning & Growth. This paper will address a subset area of Information Capital within the Learning & Growth perspective. Information Capital, like any other segment of the program, only has value in context of the overall program strategy. The figure below shows the program's strategy map. It is presented to provide context to the following discussion and reinforces the alignment required to execute the strategy effectively. Additionally, the strategy map provides a visual representation of the cause and effect relationships among the components of an organization's strategy. It provides a normative checklist for a strategy's components and interrelationships.



Learning & Growth

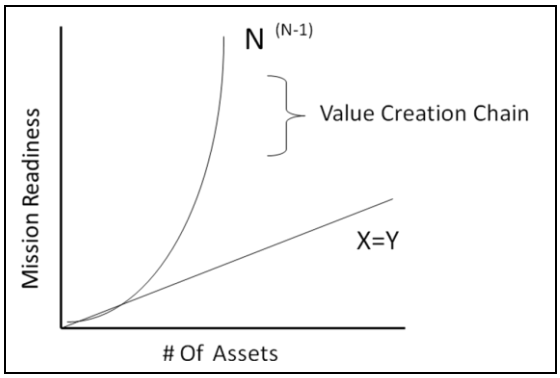
To achieve our vision, how must our organization learn and improve?



Intangible assets are the ultimate source of sustainable value creation. Learning & Growth objectives describe how people, technology, and organizational climate combine to support the strategy. Intangible assets are 75% of most organizations' value but, most organizations do not have alignment between human, information and organizational capital resources. Improvements/investments in intangible assets like knowledge and technology seldom have a direct impact on financial outcomes. This lack of direct linkage makes it harder to articulate the requirements, let alone the return on investment. Investments in individual or all areas without strategic alignment result in local optimization or unleveraged gains.

Value Creation

To provide a common frame of reference, the following perspective is provided for value creation and value (readiness).



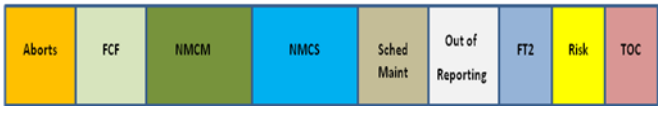
Metcalfe's Law states that the power of a network increases exponentially with the number of Nodes connected to the network. This serves as a useful reference as we seek to create value by harvesting the raw material (information, human, and organizational capital) provided across the enterprise. Expanding on the current data collection and analysis infrastructure will allow us to implement business intelligence and knowledge management[iv] tools for value creation.

Knowledge Management (KM) & Business Intelligence (BI) are umbrella terms that refer to a set of methods to improve business decision making by using fact based support systems. KM concerns itself with the facilitation of sharing that knowledge from one individual to another using technology as an enabler in the process. Business Intelligence on the other hand offers solutions for providing the right information at the right time to decision makers. And in its advanced form of predictive analytics (data mining, forecasting, optimization) it is the key factor in providing much higher levels of insight and foresight which drives the value of shared knowledge.

Value

The best ability is availability

For ease of discussion and to address the unrealized benefits discussed in the 1997 QDR/2002 DPG, we will use mission dependability as a metric for readiness with the additional areas of logistics footprint, risk and total ownership cost. Specifically, readiness includes safety, reliability, logistics and cost. These constituent elements provide the trade space for management decisions. When addressing readiness, the driving metric used for our requirement development is Mission Dependability.



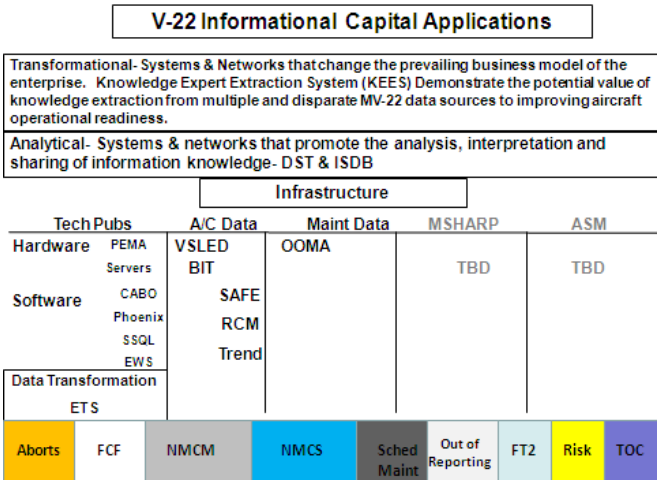
Mission Dependability

Mission Dependability of a product is the probability it will provide acceptable performance during the mission, even if maintenance is needed to sustain it.

Information Capital

Information Capital is the raw material for creating value. Information Capital, consisting of systems, databases, libraries, and networks, makes information and knowledge available to the organization. It consists of two components: information technology infrastructure and information capital applications

The below figure is information capital requirements tailored for the V-22 program.



IT Infrastructure

The Consolidated Automated Maintenance Environment Optimized (CAMEO) system integrates data from the first three areas (tech pubs, a/c data, and maintenance data). Although the certification and networking of these systems is a recent success, the individual systems need improvements in capability and sustainability.

Tech Pubs

The V-22 employs a class 4 Interactive Electronic Technical Manual (IETM). It was one of the first platforms to be developed from scratch with the necessary data structure and authoring tools. Through multiple iterations, the IETM has overcome multiple developmental challenges by maintaining a customer focus on accuracy, adequacy and usability. The time has come in the program where sustainability is also addressed for affordability and configuration management. These concerns are addressed in the program's "Data Transformation" POA&M.

Electronic Troubleshooting Suite (ETS) - The Electronic Wiring System (EWS) lagged in the development of the IETM and did not reap the benefits of a dedicated 2-year validation period during the program's operational pause. Additionally, there was latency in the appearance of wiring discrepancies on the V-22 and the need/use of extensive wiring troubleshooting information/techniques. The program's ETS addresses the discrepancies with the current EWS and is developing better fault locate tasks and graphics.

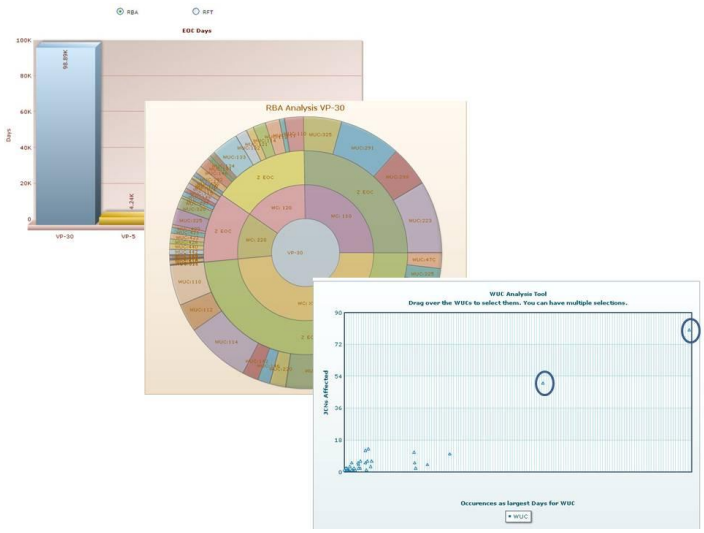
Vibration Structural Life & Engine Diagnostics (VSLED)/Built-in-test (BIT) - The current VSLED parameters and sampling rates are insufficient to exploit the benefits of the system. Additionally, the structure of the data limits its access to most users and is infrequently used in a multivariate, proactive analysis. The current system supplies information to maintainers and engineering staffs for trending and the Structural Assessment of Fatigue Life (SAFE).

Condition Based Maintenance (CBM) provides the tools and technologies to execute the weapon system, subsystem, and/or component's failure management strategy. Upgrades to the VSLED & BIT systems must account for potential improvements in detection and failure management strategies though additional monitoring and analysis tools.

IT Capital Applications

CAMEO currently automates transactional applications and networks; technical publications, OOMA, Aircraft VSLED & BIT data. Future incorporation of Marine Sierra-Hotel Aviation Reporting Program (M-SHARP) and the Aviation Maintenance Training Continuum System (AMTCS) Software Module (ASM) will enhance analytical potential by adding additional enterprise data elements for value creation. The integration of these data sources provides truly transformational application potential.

CAMEO is pursuing an iterative requirements process that balances technical and user requirements. It is envisioned that the current dashboard, a visually intuitive display of aircraft information, will be augmented with advanced maintenance management and data mining tools. Below is an example of visual analysis tools developed for the P-3 Orion community. The tool easily cascades from squadron level ready basic aircraft (RBA), to downing Work Unit Codes (WUCs), to a statistical representation of days open per maintenance action on the selected WUC. This is a basic scenario where the visualization of large datasets allows the user to quickly process large amounts of data and intuitively establish a correlation, enabling the user to spend more time on causation.



Transformational Application- Similar to existing industry Business Intelligence (BI) [v]systems, the vision is a system that can mine the data and conduct multivariate, predictive analysis. An example of this would be:

Given Selected	Would Produce
Aircrew, mission code, environment	Specific flight regime, discrepancy
Maintainer, publications, equipment	Result

The statistical distributions can be aggregated, segmented or micro-segmented as required and create value added insights.

MV-22 Knowledge Extraction Expert System (KEES)

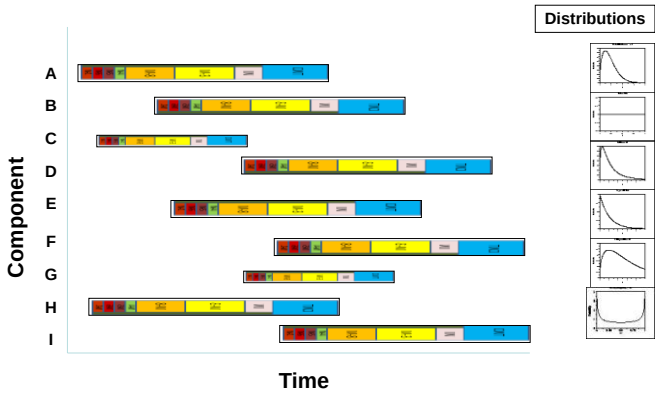
The prototype KEES will be developed and demonstrated in a research and development environment using operational aircraft flight, maintenance, and logistics related data. The focus will be on statistical analyses of mission type, frequency, and flight duration; time spent in identifiable flight regimes; dynamic maneuvers during which aircraft components are subjected to increased loads or stresses; and maintenance and logistics related data. Results will be assessed for correlations with the operational reliability of select systems, subsystems, and/or components, and the identification of anomalous performance outliers and patterns. A schema for KEES integration with the CAMEO system will also be developed.

Decision Support Tool[vi]-

How much will it move the needle?

Component level reporting and analysis do not cascade well to the system level . The V-22 program is teamed with NAVAIR 4.10 & Mantech to develop the requirements and eventual fielding of a decision support tool to help predict the future impact of current decisions. This will provide the capability to run "what if drills" to support investment decisions. We are currently using the Aviation Maintenance Model (AMM). This is model is used by the CH-53K program.

Decision Support Tool- What if scenarios



Mission capability rates are measured at the aircraft level. The next available breakdown is by subsystem capability impact reporting (SCIR) at the component level. SCIR data provides detailed information on the individual component status from the time of failure detection to restoration. It accounts for in-work, awaiting maintenance and customer wait times. The difficulty in deriving the requirement for appropriate returns on investment for component/system improvement is due to the variation in component SCIR times overlapping and the variation in failure distributions.

Aircraft are down for multiple components at a time and each component has its own distribution curve for reliability and supply support. Developing requirements for a DST requires an understanding of the dependencies within the tasks, data and information systems from which the data are collected.

In-Service database-

The GIG stops here- La Fruta del Diablo (The Fruit of the Devil)[vii]

As the CAMEO infrastructure allows for the development of analytical applications of connected databases, the remaining in-service requirements analysis resembles strawberry picking, labor intensive back-breaking work that relies on historical memories and tacit knowledge of individuals.

The in-service review (ISR), and in-service requirements management, requires the integration of information from multiple, disparate, password protected web-sites or databases. All the bandwidth in the world is useless without a password. Additionally, the content is unstructured (word, pdf, ppt, etc.) and difficult to pull content from.

The current process resembles a highly talented staff on repetitive information scavenger hunts that seldom produce one version of the truth, or at a minimum, a complete version of the truth. This produces an episodic learning style where heroic efforts to assemble all of the information are limited to crisis events.

The Fleet Support Team (FST) has begun limited work on developing a database of the in-service items. Additionally, the program developed a draft requirements document for an "in-service" information system.

Knowledge Capture Website

A formalized means of capturing explicit and tacit knowledge is required to accelerate organizational learning. The figure below represents a conceptual approach for a knowledge capture website based on a model of 12manage.com. The website would act as an encyclopedia of terms and processes used to address readiness. User groups will be formed and conversation threads will be presented below the information to provide feedback for the iterative requirements process as well as spread the use of the material from the organizational level to the enterprise level.

NMCM	NMCS	Scheduled Maint	Aborts	FCF

Elapsed Maintenance Time (EMT)

Direct Maintenance Manhours/ Flight Hour (DMMH)

Direct Maintenance Manhour/ Maintenance Action Form (DMMH/MAF)

Awaiting Maintenance Time(AWM)

M-1

M-2

M-3

M-4

M-5

M-6

M-7

M-8

Concluding Remarks

Although Ishikawa diagrams and house of quality templates are normally associated with systems engineering, the Balanced Scorecard (BSC) is an alternative method to establish cause & effect. This method was invaluable in determining requirements and decomposing high level strategy into tangible/actionable requirements. Additionally, it helped articulate the intangible assets' hidden potential when aligned with the other BSC perspectives.

[i] Report- Report of the Quadrennial Defense Review, Sect VII, Transforming U.S. Forces, May 1997

[ii] Book- Kaplan, Robert S., and David P. Norton. *The Balanced Scorecard: Translating Strategy into Action*. Boston, MA: Harvard Business School, 1996. Print.

[iii] Book- Kaplan, Robert S., and David P. Norton. *Strategy Maps: Converting Intangible Assets into Tangible Outcomes*. Boston: Harvard Business School, 2004. Print.

[iv] Video- Smith, Nick. "History of Business Intelligence." *YouTube - Microsoft BI TV*. Microsoft BI TV, 01 Jan. 2010. Web. 12 Jan. 2011. <http://www.youtube.com/user/wowmsft#p/a/f/0/_1y5jBESLPE>.

[v] Book- Taylor, James, and Neil Raden. *Smart (enough) Systems: How to Deliver Competitive Advantage by Automating Hidden Decisions*. Upper Saddle River, NJ: Prentice Hall, 2007. Print.

[vii] Farm work has, for most crops, become no easier since Steinbeck's day. Strawberries, the crop the Vegas started out with, are nicknamed *la fruta del diablo* (the devil's fruit) because pickers have to bend over all day

Periodical, Arvin, "Field of Tears" The Economist, 16 December 2010,