Will-Cost and Should-Cost Management – It's Not Business As Usual

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Abstract

In April, 2011 Under Secretary of Defense for Acquisition, Technology & Logistics Ashton Carter issued the Memorandum – "Implementation of Will-Cost and Should-Cost Management". The memo defines implementation of Should-Cost and Will management for all ACAT I, II and III programs and lists "Selected Ingredients of Should-Cost Management". Thus, each organization involved with these programs must successfully deal with the challenges or planning, coordinating and managing Should-Cost/Will-Cost programs and have the necessary tools to quantitatively manage them through their life cycle. This extends much further than parametric estimating, and includes integrated database management to capture, store and analyze historical data. In addition, a fully integrated framework is needed to successfully store, analyze and produce both budgetary and Independent Cost estimates. This paper, using the TruePlanning model as an integrating framework will explore:

- Benchmarking using cost research knowledge databases based on both military and commercial programs in addition to specific program history.
- Supply chain concepts to analyze and understand impact of competition and cost incentives.
- Robust capability to quickly select alternative technologies/materials and quantify impact on lifecycle costs.
- Ability to model different vendor scenarios.
- Understanding of key technology and schedule parameters their interaction on cost.

These concepts will be demonstrated via a case study approach to show how you organization can implement a comprehensive framework for Should-Cost and Will-Cost Management.

Should-Cost/Will-Cost Management

Background

In a prelude to his April memorandum (jointly with Robert F. Hale, Under Secretary of Defense Comptroller/CFO) Ashton Carter, issued a memorandum for Acquisition Professionals in September 2010 on the subject of better buying power. Mr. Carter intended that the memorandum serve as guidance for obtaining greater efficiency and productivity in defense spending. Twenty-three (23) principal actions were identified as potentials for achieving greater efficiency and productivity, though it is worth noting that neither efficiency nor productivity are defined in the Carter memorandum. Under the generic definition for both terms, we will proceed with premise that greater efficiency means same or greater output with less input and that greater productivity means greater output with same or less input.

One of the 23 actions is to drive productivity growth through Will-Cost/Should-Cost management. What is Will-Cost? It is a forecast of program cost based upon reasonable extrapolation from historical experience. Will-Cost often defines the program budget. It is also an impediment to achieving the efficiency and productivity improvements called for. Yes, it is business as usual and a self-fulfilling prophesy all rolled together. But, until the market place demonstrates the ability to break away from tradition, planning a program around variation from the norm is risky.

In an attempt to interrupt the vicious cycle of Will-Cost, Should-Cost is introduced as an on-going practice to drive down program cost with tools that identify and encourage improved efficiency/productivity. So, while program budgets will continue to be Will-Cost based for the near term, adoption of Should-Cost practice components are seen as not only realizations of savings opportunities, but also as agents in narrowing the gap between Will-Cost and Should-Cost so that future budgets will become more Should-Cost based.

Should-Cost/Will-Cost management then is constant attention on all elements of program cost for cause and effect so that savings potentials can be identified and analyzed. Those with the greatest opportunity for success are implemented and results monitored so that savings can be quantified. While the management practice is the responsibility of the government, suppliers are incentivized monetarily. Common sense suggests that suppliers are also assimilated into a partnership with government to streamline the effectiveness of the process.

The Should-Cost/Will-Cost practice is not disassociated form the other 22 actions of the Carter memorandum. For example, the cost targets of the Affordability Requirement action are the results sought by the Should-Cost improvements. They quantify the amount of overall productivity/efficiency improvement expected over the life of the program. In fact, many other actions from the list of 23 can be viewed as specific areas for scrutiny in moving the Will-Cost to the Should-Cost; reduction of non-productive processes and bureaucracy and reduction of non-value added overhead imposed on industry are two examples. One can make the case that Should-Cost/Will-Cost management is the disciplined practice by which the other 22 actions are executed.

TruePlanning in a Should-Cost Management Framework

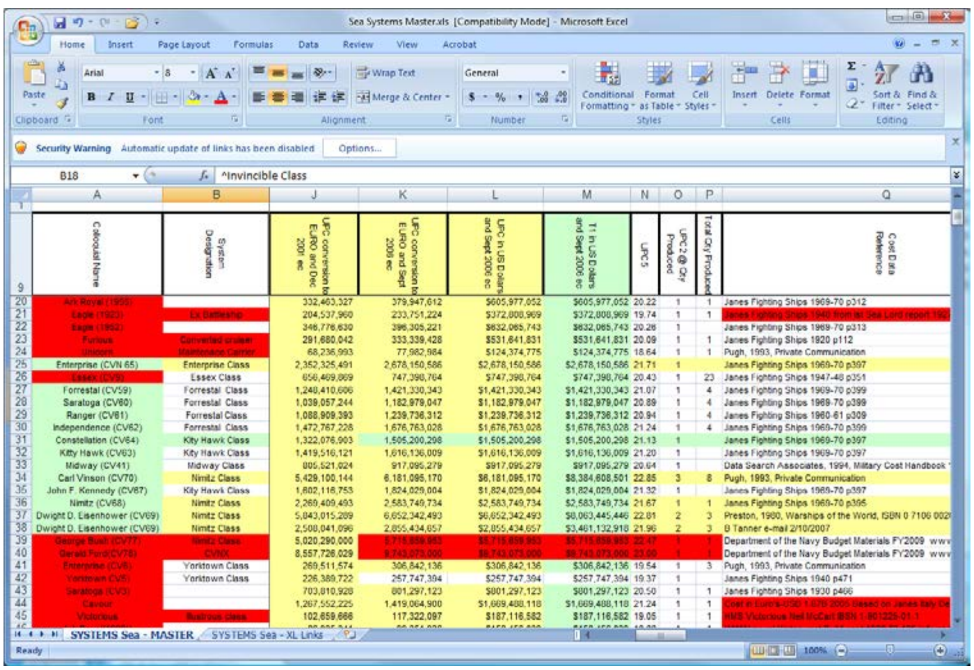
Should-Cost management depends upon business practices that provide up-to-date and accurate information. In the early stages of a program, the information enables development of realistic plans. As the program evolves, the information serves to both monitor progress in achieving goals and alter plans when the program is off-track. What kind of information? Everything that is target related, usually cost, schedule, capability, features, quality, reliability, performance, and more.

Information Systems constantly strive to meet business management needs. From a beginning as stand-alone and stove-piped databases and applications for a variety of functions (Human Resources, Material Requisition and Planning, Financial Operations, etc.) to the Enterprise Resource Planning (ERP) push to integrate all of this over the past 25 years, it has always been about giving decision makers the right information at the right time so that effective decisions can be made. The state of meeting that simple objective varies across markets of the industry. Some have succeeded in developing effective integrated information frameworks, but just as many, if not more, have failed. While it is not the intention of this work to delve into the subject of current effectiveness of integrated information frameworks, it is important to establish that this is a movement still in its infancy – no mature standard has been established. Thus, any challenges to establishment of Should-Cost management as a business practice are further aggravated by challenges in establishing an information framework useful in executing the practice.

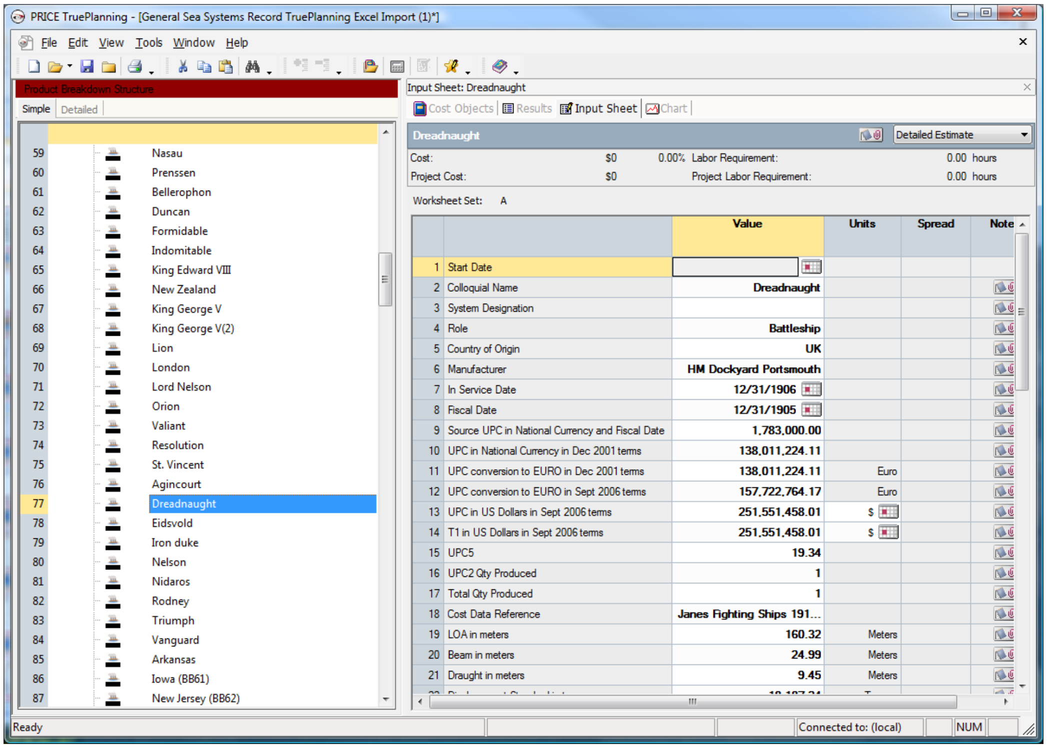
At a minimum, Should-Cost management needs an information framework that can capture, store, and analyze historical data. TruePlanning is one framework that can do those things.

TruePlanning captures data through its ability to inter-operate with other software tools that produce the data useful for Should-Cost management. This is accomplished in a variety of ways, with the specific capability dependent upon the architecture of the other software. For instance, software using or producing Microsoft Excel formatted data sets are easily interfaced with TruePlanning through either import (TruePlanning contains an Excel import function) or use of customized interface via COM (Component Object Model). In the latter case, TruePlanning is launched and executed directly from Excel. In this way, TruePlanning not only captures data from another application, but it also allows the other application to capture data it has produced.

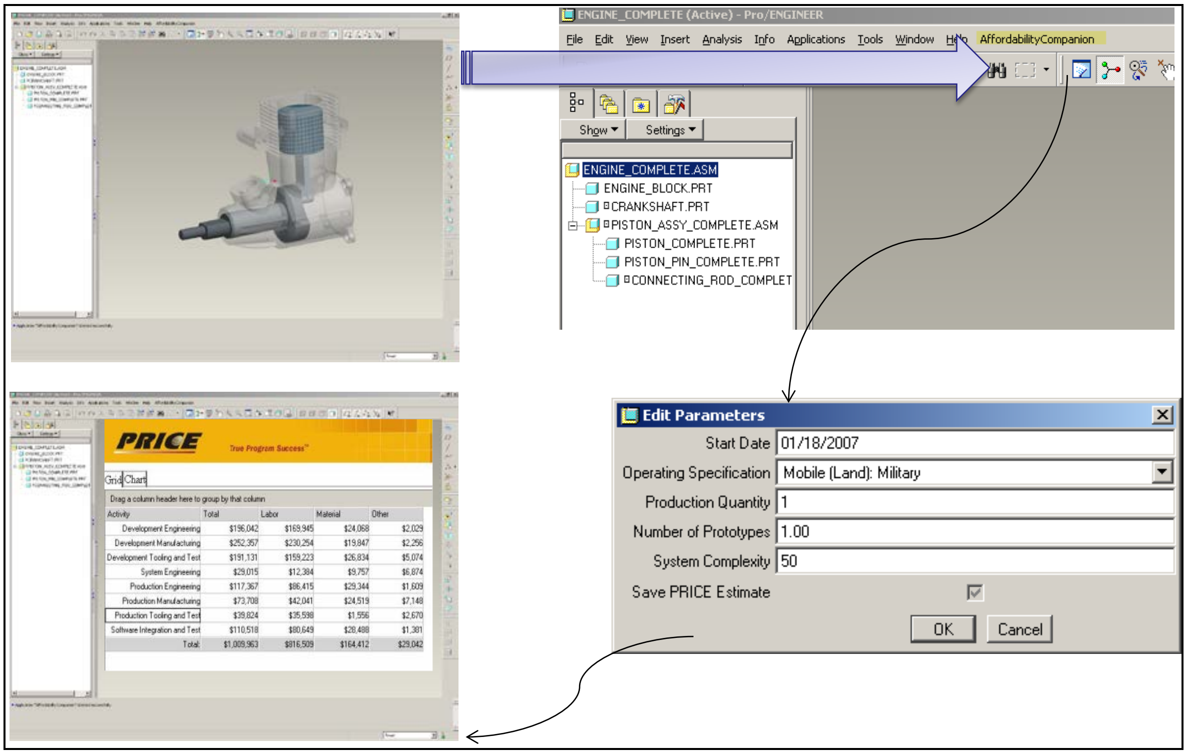
An Excel workbook containing publicly available naval vessel data demonstrates the data capture with TruePlanning. The figure below shows a portion of the data in Excel format.



A custom catalog for TruePlanning is developed with the companion program, TrueAnalyst to create a cost object record for each line of the Excel workbook. A line represents one vessel. Each of the data columns become an input to the sea system cost object created with TrueAnalyst. Once developed, the custom catalog can digest any number of vessels for conversion to TruePlanning Cost Objects. The catalog development time was approximately 4 hours in this case. A sample display of the data captured within TruePlanning is shown below.

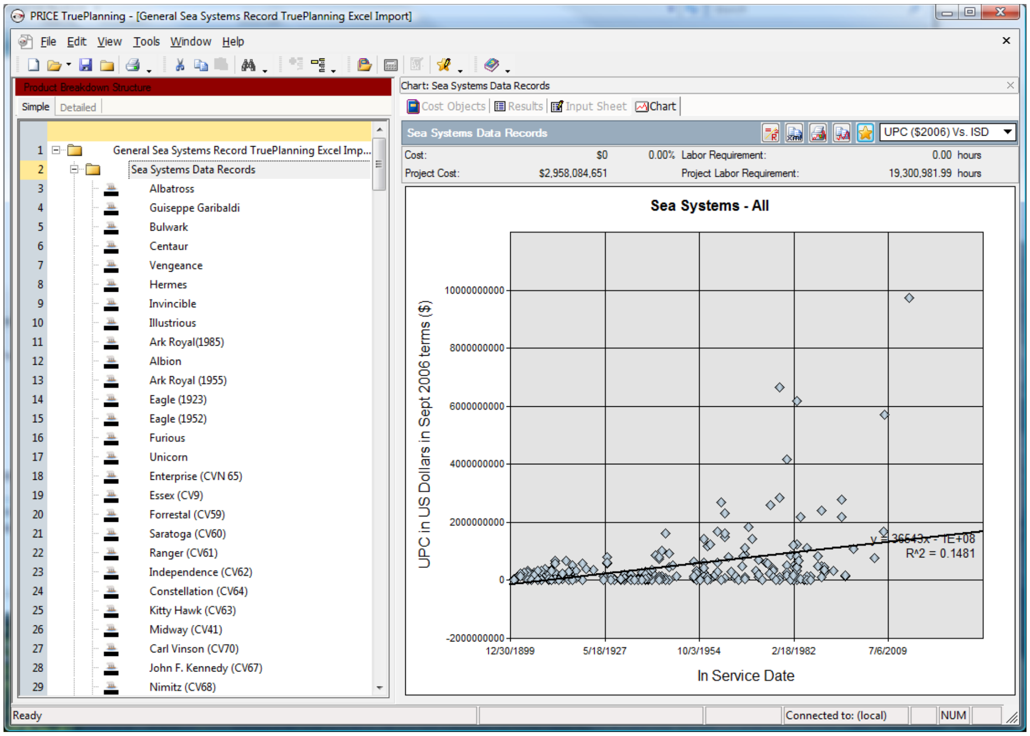


As mentioned earlier, there are other methods within TruePlanning for data capture. One is to develop a custom interface via web-services. An example of this is the Affordability Manager of Pro/ENGINEER. Pro/ENGINEER (or ProE for short) is a three-dimensional design tool used for mechanical systems. The diagram that follows illustrates the ProE/TruePlanning integration. The interface is represented by the Affordability Companion command added to the ProE command line. When invoked, the command opens an input dialog requiring answers to only a few simple questions. The answers are coupled with ProE design data to create a product breakdown structure for the mechanical item pictured and to populate the TruePlanning input fields for each item of the breakdown so that a cost can be estimated. The cost is displayed in an array within ProE, lower left portion of the diagram.

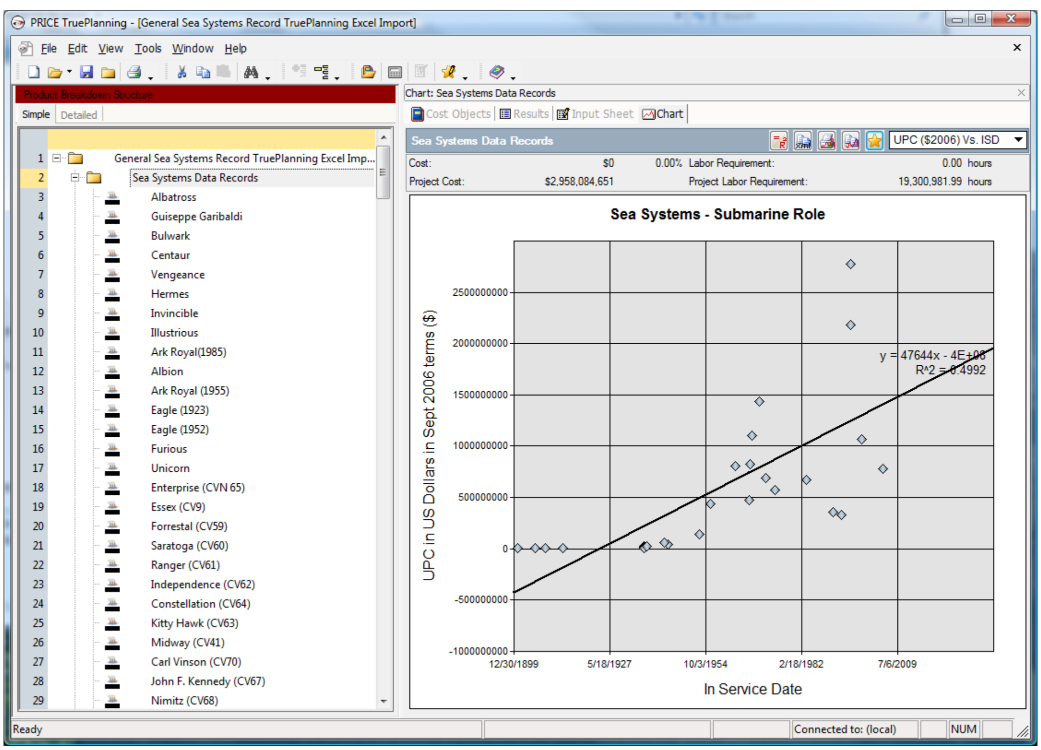


These examples demonstrate the data capture and data store functions of a Should-Cost framework. It is analysis that transforms data into information and continuous evaluation of information that creates knowledge. So, analysis may be the most important aspect of a good framework. To see how this can work with TruePlanning, we pick up where we left off with the naval systems earlier.

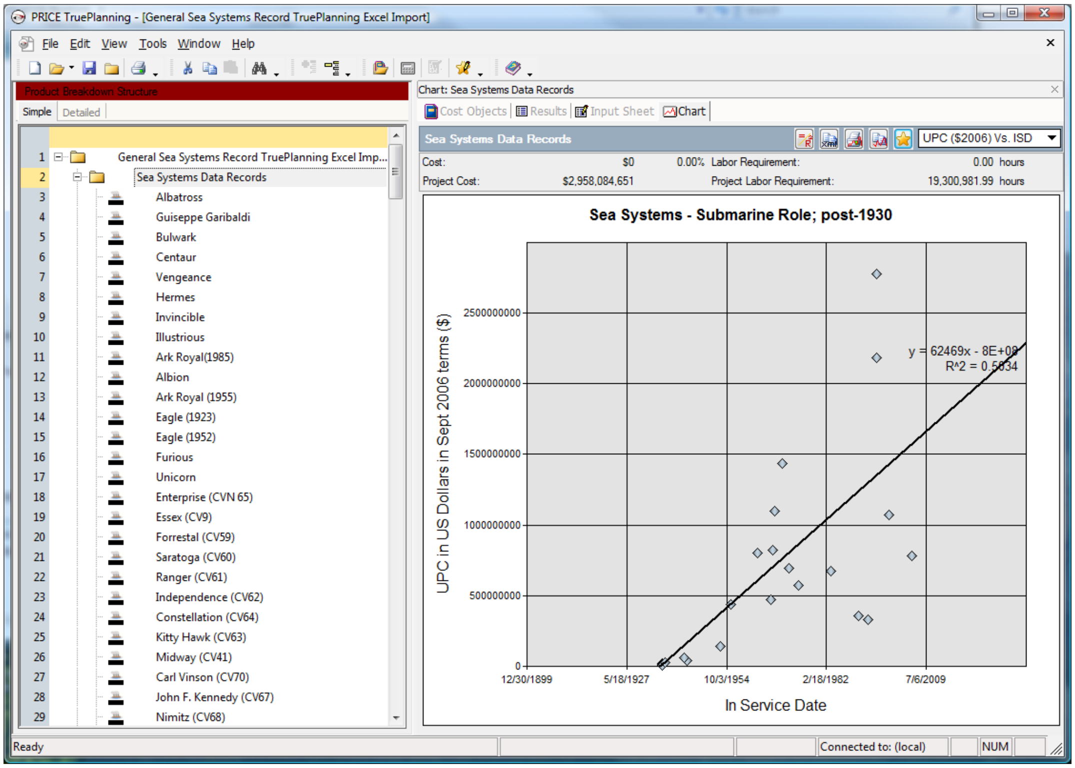
TruePlanning contains a charting capability that allows for pair wise evaluation of all data fields. The figure that follows shows an example for the In Service Date and Unit Production Cost of each vessel of the database. The chart shows an expected unit cost rise due to ships becoming more capable over time – i.e. able to travel faster, farther, and safer than earlier ships. Keep in mind that unit costs have been normalized for each ship to keep economic escalation out of the picture. But, if we are seeking a cost estimating relationship to use for a proposed new submarine, this data is not very useful. The coefficient of correlation (R^2) is too low. Before we dismiss this data, lets drill down a bit; there may be useful information that is concealed by an abundance of irrelevant data.



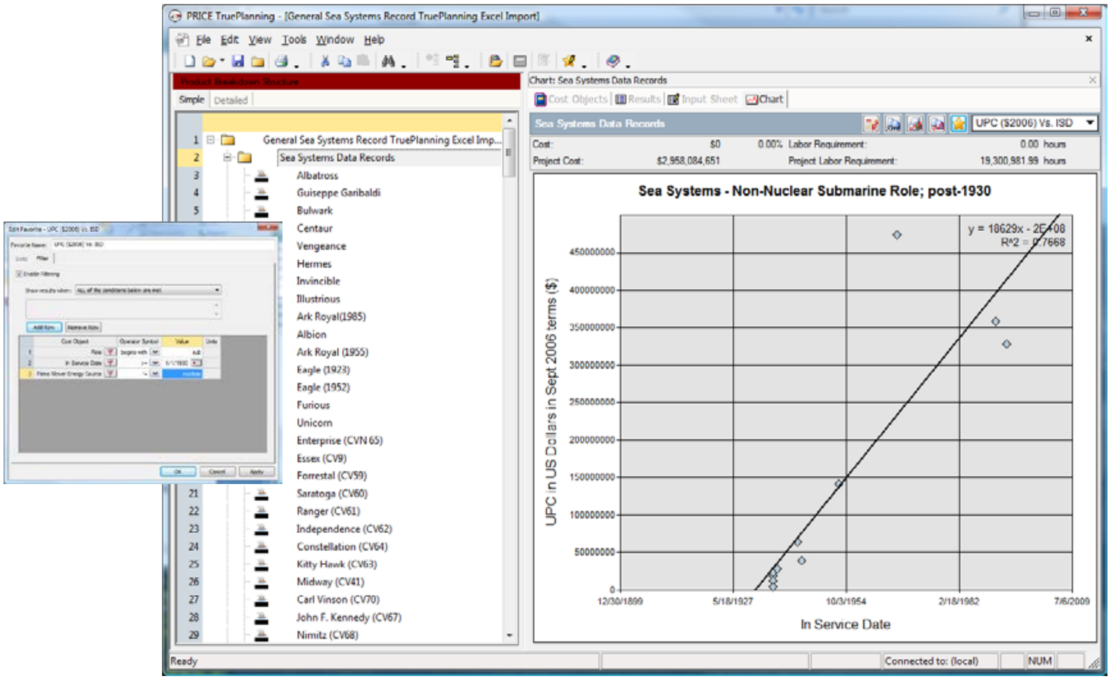
Our new ship of interest is a submarine. The data above includes submarines and surface ships. What would we have if we filtered the surface ships? The answer is shown below. While the results are better, there remains too low of a correlation coefficient for accurate estimating.



Even though filtering has eliminated all records with 0 unit cost, the graphic above shows very low unit costs for submarines prior to 1930. It also appears that inclusion of ships prior to 1930 produces a trend line that can estimate negative values. All the more reason to filter out the prior to 1930 In-Service-Date records.



As expected, these results are better, but still not quite good enough. The final filtering removes all nuclear powered submarines, resulting in a model we can use for estimating unit cost from relevant information and with a high degree of confidence.



Stratification of data into common groups is important to understanding the information buried within mountains of data. As was the case with the conventional submarine example, the stratification is often logical. However, stratification can sometimes be surprising. It is best to analyze all of the data when establishing strata so as not to accidentally dismiss a correlated relationship that is not immediately considered to be a candidate.

Benchmarking Suppliers

Should-Cost/Will-Cost management targets major system acquisitions. The costs of such systems are usually heavily dependent upon supplier costs. Therefore, one of the bigger areas for Should-Cost scrutiny is in the supply chain network.

There are a variety of ways to manage suppliers. However, any method that does not subject a supplier to sole and immediate accountability for his/her behavior is likely to result in the supplier becoming a, “free rider.” Free rider is a term used in economics where one enjoys benefits without working for them. Rather, the free rider passes his/her work on to others who must pick up the slack. Free riders are inevitable in non-cohesive teams where everyone shares the outcome to which they contribute or are expected to contribute. The Boeing 787 program has been cited as free rider incentive supplier management example. And, supplier delivery problems are one of the two main reasons for the many delivery delays of that aircraft program.[1]

To drive Should-Cost through to suppliers, the system integrator must hold suppliers accountable while insisting on productive, efficient, and fair terms – i.e. supplier prices that are balanced for

[1] “Why 787 Slips Were Inevitable,” *Aviation Week & Space Technology*, February 28, 2011, Yao Zhao, Aaron Shenhar, Supply Chain and Project Management professors, Rutgers University.

all participants – the supplier, the system integrator, and the end user/customer for the system. How is this done? By benchmarking suppliers.

Benchmarking is like indexing in that goods and services of a like kind from a variety of sources are compared with a common denominator so that a knowledge-based choice of one source (supplier) over others can be made. The denominator can be any product characteristic of importance to the party making the selection. Reliability, attractiveness, feature quality, and price are all candidates. If no one characteristic is most important, a metric than combines those which are most important is created for comparison.

Benchmarks can be purchased, but there are often limitations and uncertainty in those which are purchased. The most well understood benchmarks are those developed by acquisition/purchasing organizations. Such benchmarks, by necessity, focus on the products of concern to the organization and to the level of characteristic definition appropriate to decision making.

Because benchmarking is measurement based, information intensive, objective, and action-generating, it may represent the greatest opportunity available for higher productivity/efficiency in the world of Should-Cost/Will-Cost. Remember, Should-Cost limits consideration to existing configuration. With so much of a major system being composed of supplier produced items, driving suppliers to greater productivity/efficiency is a must.

The US Government Accountability Organization (GAO) has identified the need for reliable cost information as being greater now than ever. Reliable cost information enables accurate comparison of alternatives on the basis of their costs/benefits. GAO also views reliable cost information as necessary for identifying potential cost control, efficiencies, and waste. Further, reliable cost information validates results of benchmarking. Because of its importance to Should-Cost/Will-Cost management, an example dealing with hydraulic pump benchmarking follows.

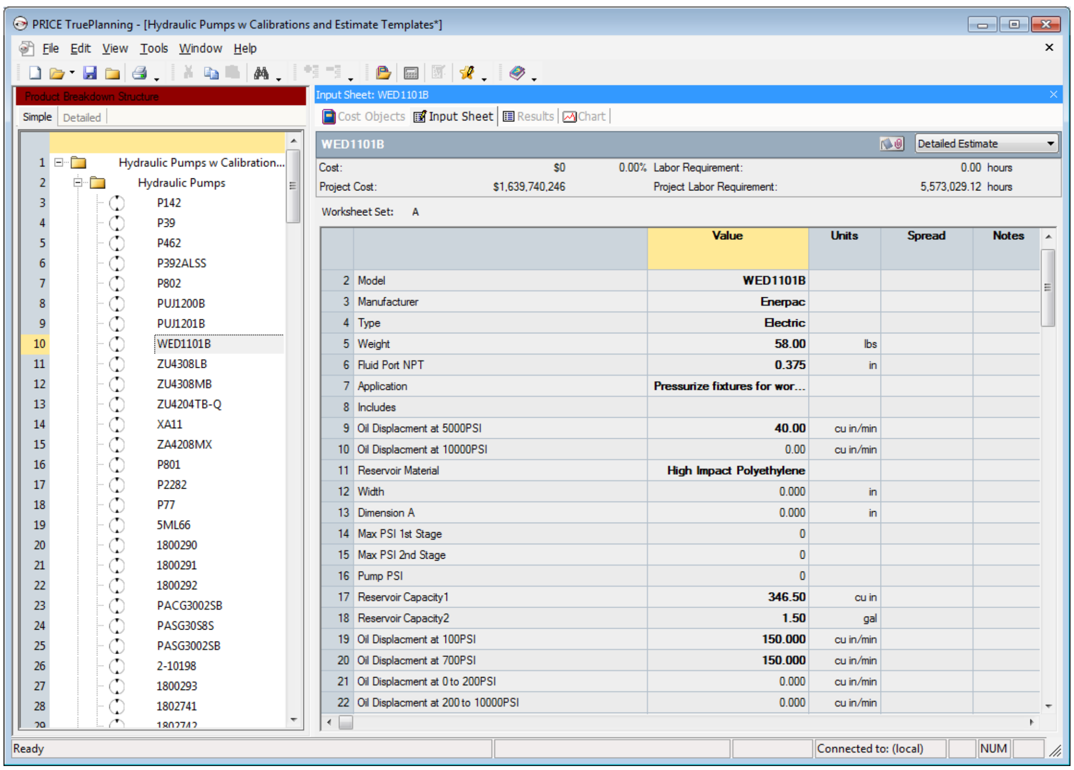
Supplier Benchmark Example – MT Industrial Products

MT markets large industrial systems for a variety of manufacturing and service industries (automotive, construction, mining, marine among them). MT systems are a combination of components purchased from suppliers integrated with specialty components made by MT. Approximately 5 years ago, MT initiated a supply chain management practice to reduce supplier costs in a fair manner and by a reasonable amount; the initiative included benchmarking supplier costs. The benchmarking goal was to produce a reliable cost metric for use in supplier negotiation. This example deals with one market item MT purchases from suppliers - hydraulic pumps.

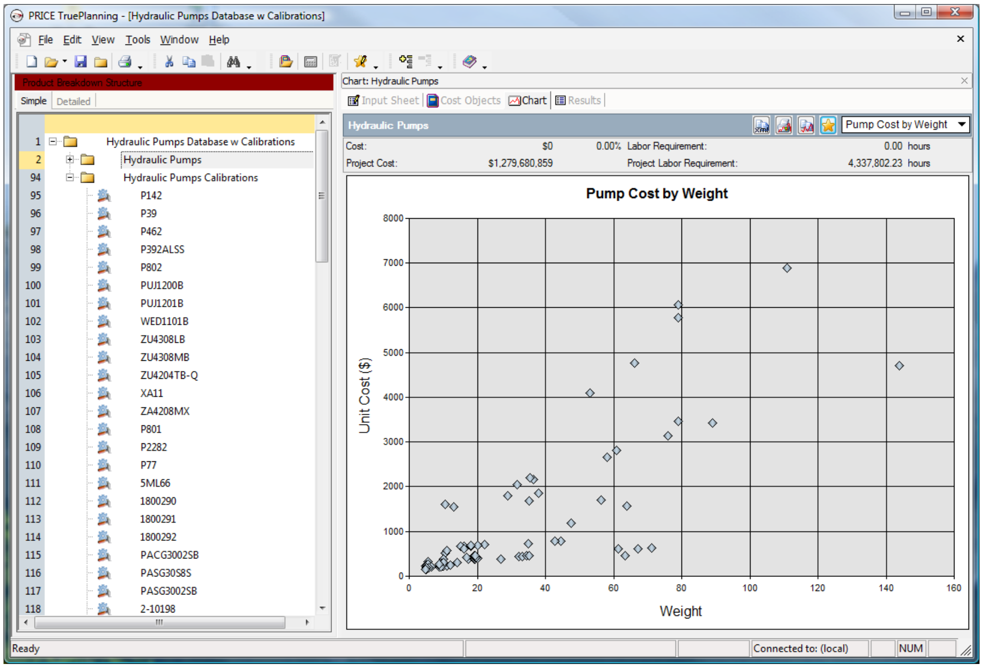
The process began with development of a pump database containing all of the cost and technical information for every pump purchased or considered for purchase (i.e. a pump proposed by a supplier but not selected by MT). The table below summarizes the database contents.

	Number	Examples
Records	90	Restricted to data no more than 5 years old.
Data Fields per Record	120	Model, Weight, Size, Displacement, Capacity, Flow, Pressure, Unit Cost; multiple fields for many of these; contents vary by pump type.
Pump Types	7	Air, Electric, Gear, Hand, PTO, Submersible, Synchronous
Suppliers	8	Enerpac, GKS-Perfekt, Haldex, John S. Barnes

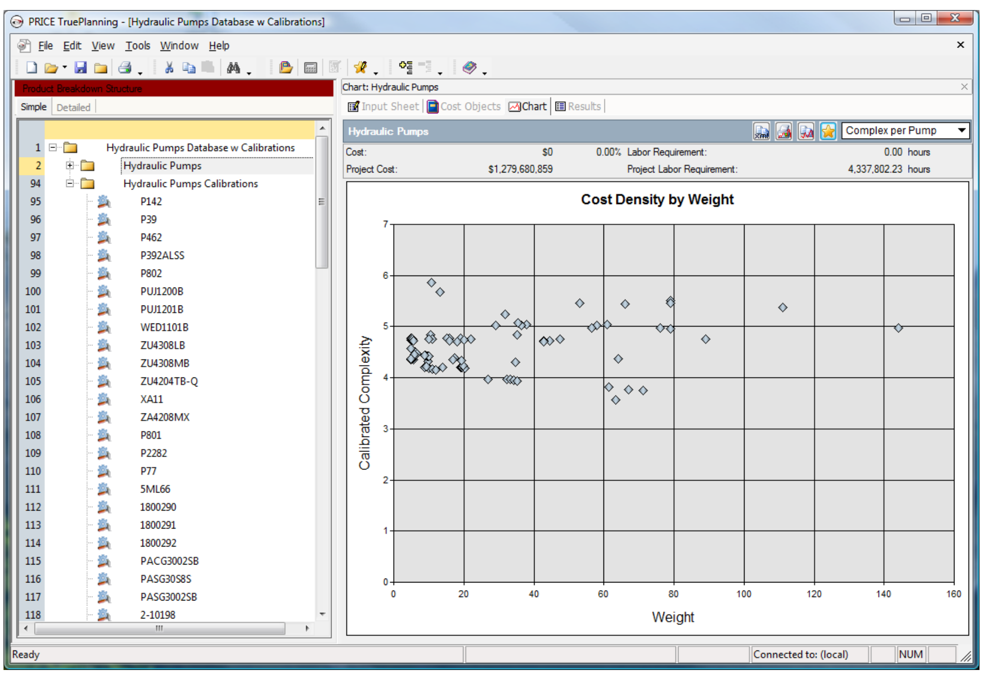
A custom catalog was created to store and analyze the data with TruePlanning; a screen shot follows. A primary reason for using TruePlanning is for determination of a cost metric for each pump – cost density. Cost density is the result of calibration of the unit cost for each pump against its weight. Recall that MT desired a fact based metric approach to supplier negotiation; the cost density is that fact based metric.



With up to 120 pieces of information in the database for any given pump, it might seem that the raw data should provide adequate benchmarking capability. A natural question then is, why is a metric necessary? Quite simply, a metric enables comparison across the data base by expressing pump value in common terms. With a variety of types, sizes, costs, and bases for the costs (e.g. quantity, currency value at time of purchase/quote), the data in its raw form is biased. Calibration normalizes all of the pump characteristics so that the cost density represents pump value for one unit at one pound. As the scatter-plot of unit cost by weight for all pumps (below) shows, there is a clear trend, but the variation is too high for effective supplier management.

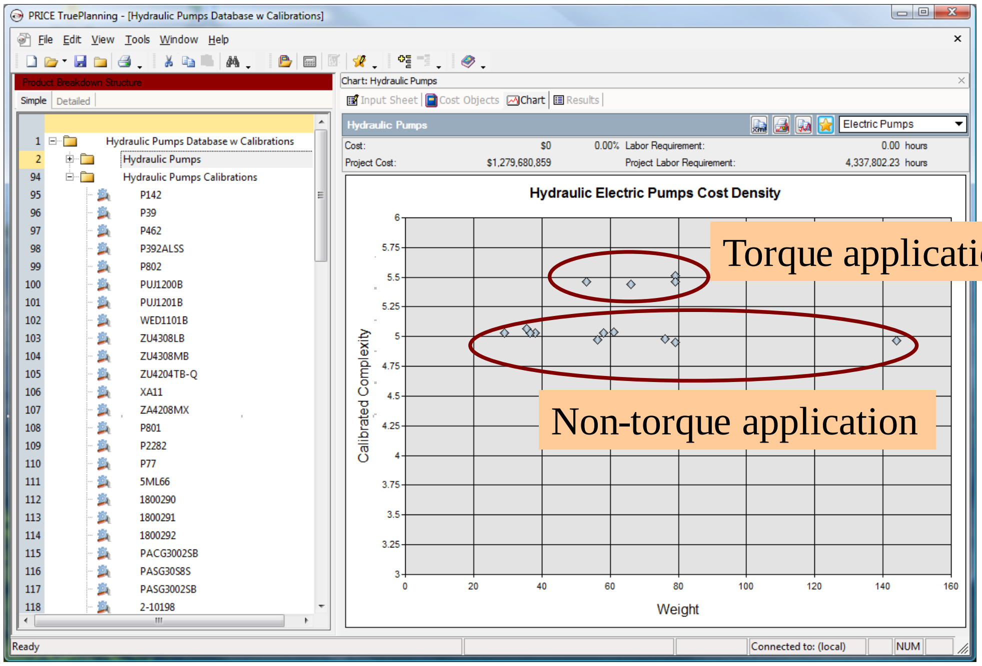


The scatter-plot of cost-density versus weight that follows shows that pump value is far less a function of pump weight, as suggested by the plot of the raw data. However, too much variation remains with the density scatter-plot. Another view is needed.



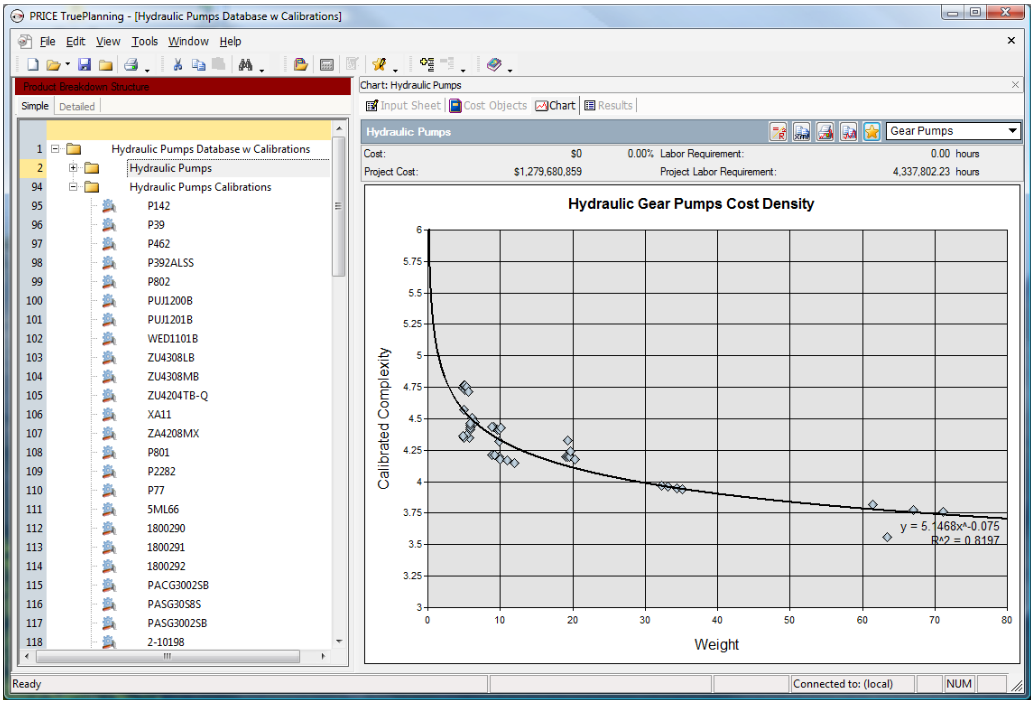
Viewing pump cost-density by pump type begins to produce the metric stability desired for supplier assessment. As the graphic below shows, it is sometimes necessary to bring into play a second variable to achieve stability. In this case, the second variable (after type) is application.

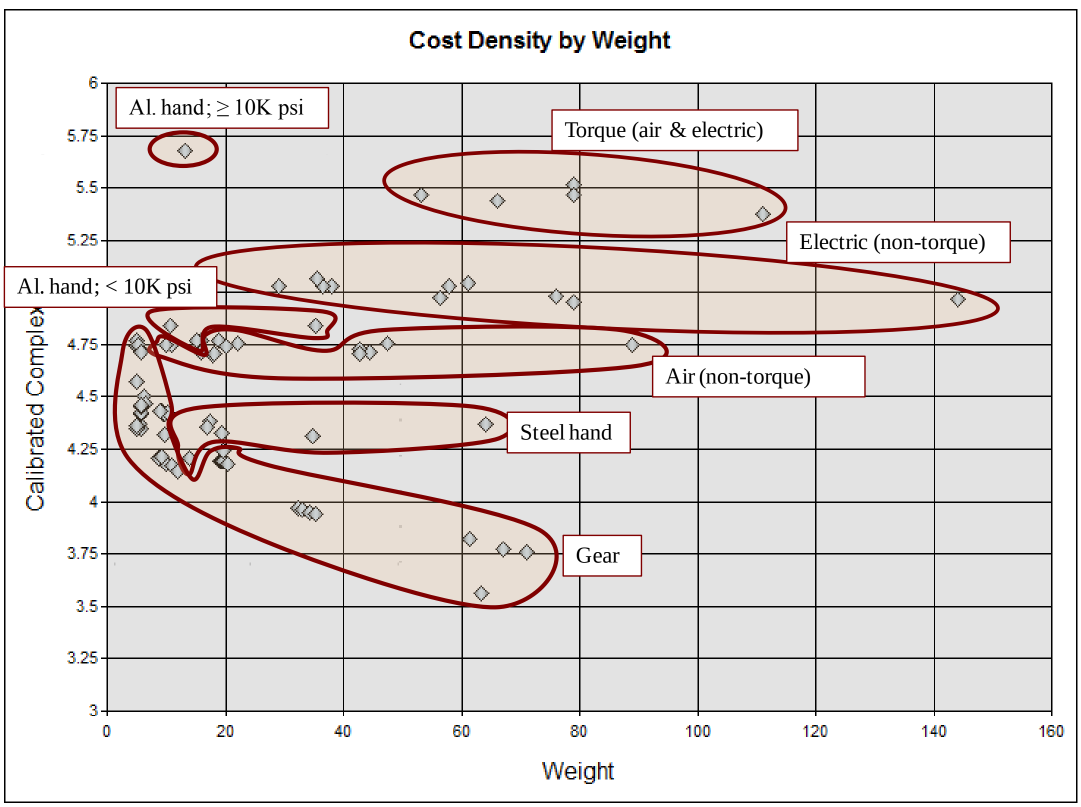
For electric powered hydraulic pumps, the torque application pumps are of a higher cost-density than the non-torque application pumps. Notice that this observation eliminates weight as a driver since the values are nearly identical for each application type of electric hydraulic pump.



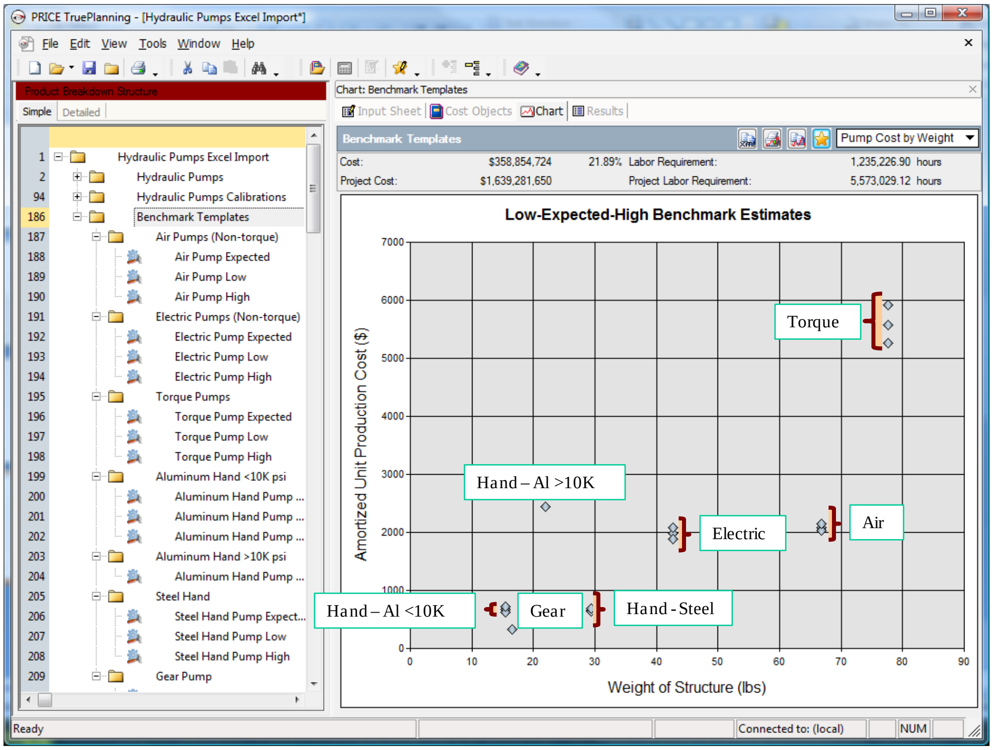
Each pump type is evaluated in this manner so that a low variation cost density relationship is established. For some, like air driven pumps, the torque and non-torque application defines the cost density. For others, additional pump characteristics are required to produce the desired low variation, predictable metric. In such cases, a fixed value may not emerge. Such is the case with hydraulic gear pumps, which are characterized by a cost density that is weight dependent – see below.

The final picture of the pump benchmarking is as shown in the graphic on the following page. Boundaries are drawn around each pump strata. Notice that some strata conform to the pump type field (like gear pumps), some are combinations of types by application (the toque pumps that are either air or electric driven display the same cost density property), and others are specific applications by type (air powered non-torque is of lower cost density than electric powered non-torque). This stratification represents the benchmarks by which any pump from any supplier will be valued. Any supplier will have difficulty refuting an estimate based upon the pump density relationships shown because they are all founded on documented, factual prices and the density data is tightly clustered.





When applied to assess supplier quotes, these benchmarks provide very little margin for error. An illustration of this fact is shown below where there variation in density for each stratum is applied to the average weight of all data points within a stratum.



As this example demonstrates, product grouping is crucial to benchmarking. It will identify the common denominator expected from benchmarking. And, while a single metric value with low variation is a highly desirable benchmarking outcome, it is not always possible. With highly complex and/or advanced technology products, a single value metric applicable to all products within a stratum is unlikely. Product performance characteristics often drive metric values. For example, it has been shown that cost density increases predictably with technology advances that improve battery efficiency. Finally, any useful benchmarking will be the product of thorough data verification, validation, reduction, normalization, and analysis. Benchmarking is time-consuming, but the knowledge emerging from benchmarking is invaluable to Should-Cost/Will-Cost management of suppliers.

Technology Refresh

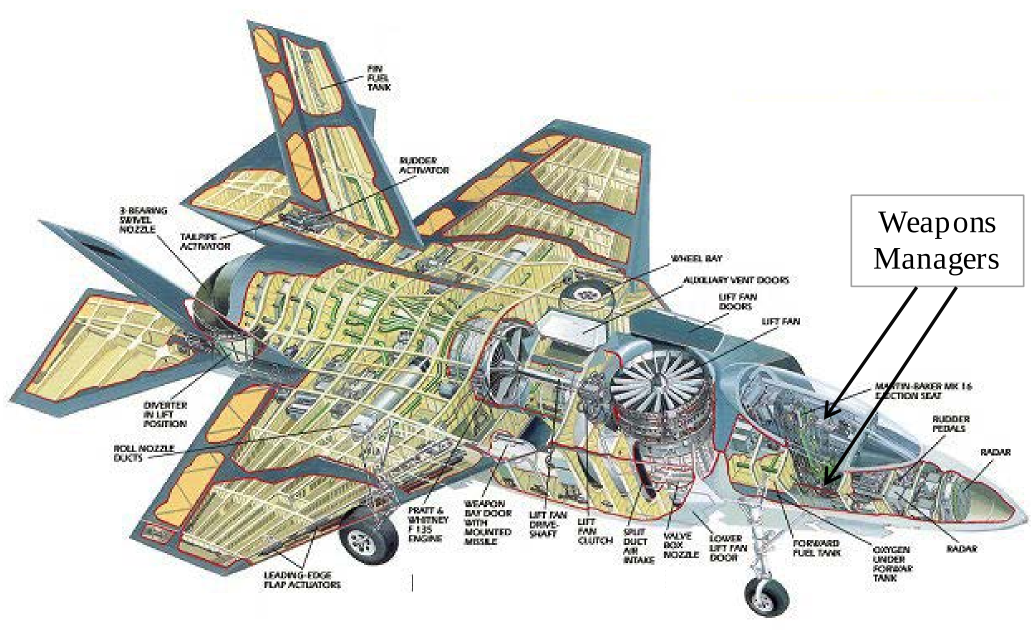
Late in the last century, DOD began to seriously examine the concept of technology refresh, or tech refresh for short, as an initiative to combat obsolescence in aging systems. The concept of Technology Refresh is derived from the idea that people responsible for electronic technology only think about making changes when a change is necessary. In other words, if things are not broke, then why fix them. However, for users of older electronic technology there is a greater risk of failure, greater cost associated with maintaining the equipment and increased cost of repair. Technology Refresh is all about establishing a plan for the future today using a methodical process that invokes a clearly defined strategy when "it" breaks. It is akin to having an insurance policy that is invoked for protection when needed, versus having no protection on a burning structure that will ultimately disrupt all activities and affect all aspects of operation.

Tech Refresh is another practice supporting Should-Cost /Will-Cost management. It may appear to violate the Should-Cost ground rule of no design changes to achieve greater efficiency/productivity. However, when a technology change is planned, it is a Should-Cost Management practice. Item 10 of Attachment 1 to the Carter April 2011 memorandum cites the following as an ingredient of Should-Cost Management:

> *Identify an alternative technology/material that can potentially reduce development or life cycle costs for a program. Ensure the prime product contract includes the development of this technology/material at the right time.*

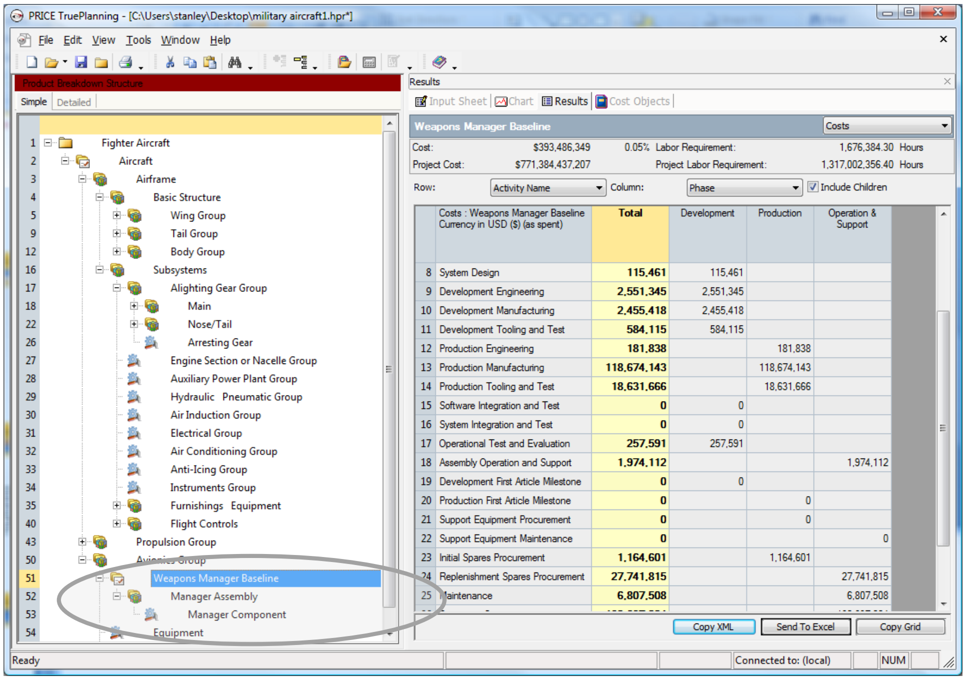
The F-35 aircraft program contained the requirement for inclusion of tech refresh at four points in time during the acquisition of the aircraft. Proposal instructions required identification of the planned refresh and its impact on total program (life cycle) cost. With a baseline of no tech refresh, the estimated savings is the difference between the baseline and the acquisition with tech refresh. The trade-off boils down to more being saved in production and O&S than is spent in R&D. An example for an F-35 weapons management interface assembly follows.

The F-35 Weapons Manager is a flexible remote interfacing product tailored to the fighter aircraft. It supports weapons functions by distributed I/O of management and actuation controls. Data used for this example is sanitized from that of the actual program. However, the process is exactly as portrayed here and the scope of results are similar those of the actual program. Each aircraft contains two identical units, located on either side of the fuselage, as illustrated below.



Baseline – Will-Cost

The baseline case calls for a development of 15 prototype aircraft, followed by production of 2880 aircraft. Production spans over 20 years and is carried out with a Low-Rate-Initial Production (LRIP) phase followed by 4 lots of multi-year (5) buys. The operational concept calls for 10 to 15 hours average operational flight time per month per aircraft over a 50 year operational lifetime. Unit maintenance is repair by contractor. The TruePlanning baseline (Will-Cost) structure is shown below. Note that the weapons manager is deep within the aircraft structure.



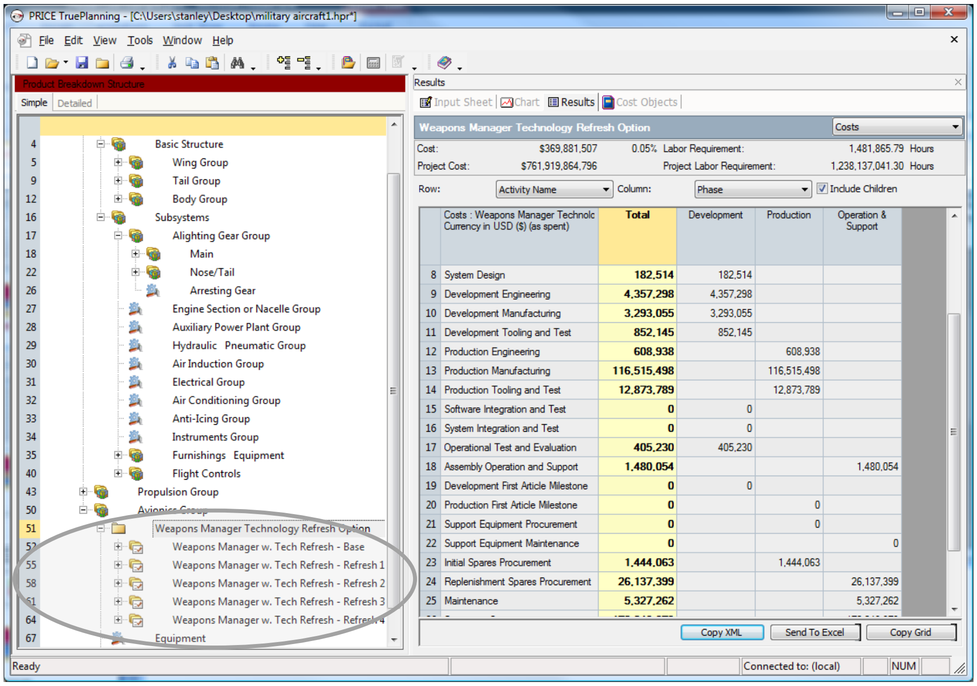
Opportunity – Should-Cost

The Should-Cost opportunity calls for a tech refresh prior to each of the 4 multi-year lot buys. This requires 5 instances of weapons manager subsystems where there was one instance in the baseline. The 5 instances are the baseline development and LRIP with the baseline technology plus 4 variations on the baseline for the 4 different tech refreshes. Each of these includes a short development and test phase to validate the tech refresh, followed by a 5-year lot production phase. The estimate structure with this case is shown below.

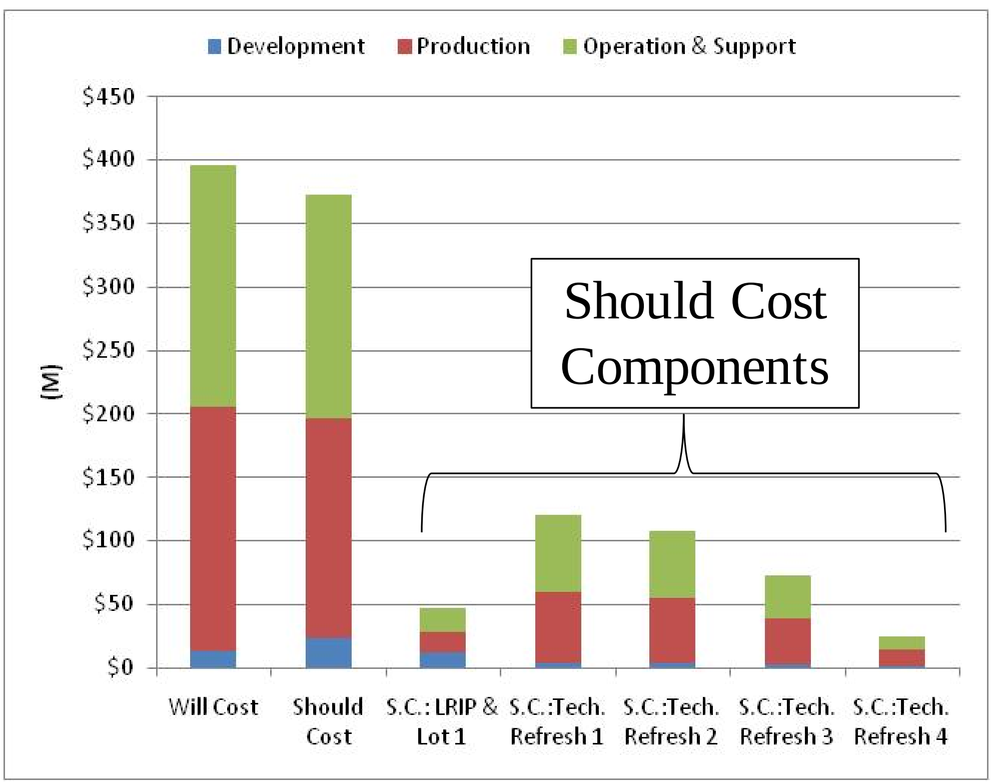
The Payoff

The graphic that follows shows the Will-Cost and Should-Cost comparison side by side along with the Should-Cost components (systems instances). The Should-Cost is estimated to be $34M less than the baseline over its production and O&S phases. To achieve these savings requires an estimated $11M additional development for the tech refreshes. This nets an estimated savings of $23M, which is 6% of the baseline. A fair question might be, is a 6% savings over a 50+ year lifetime really an exciting opportunity? In the world of defense systems, 6% is often viewed as noise level perturbation.

Should-Cost/Will-Cost ground rules limit the amount of savings that can be realistically expected from improved productivity and/or improved efficiency. Anything above 10% suggests a terrible acquisition baseline plan, where the savings are not savings at all, but corrections that stem the hemorrhage of wasteful spending. When addressing the benefit of Should-Cost/Will-Cost, it is often best to address what additional capability is made possible by the savings rather than the



percentage the savings represent to the whole. If only 25% of the F-35 subsystems were to achieve 6% savings over the baseline through tech refresh, $12B would be freed to fund another capability venture – that's $3B more than the annual operating budget of Toronto!



Another point to remember is that the 4 lots represent schedule induced opportunities for introduction of tech refreshes. Is a tech refresh every five years really needed? Is it possible that three tech refreshes might produce greater savings? Perhaps two would be even better. These are legitimate questions that can be rapidly addressed through a framework that aligns to the program structure with cost drivers that are sensitive to variations in Should-Cost management assumptions.

As a colleague once said, Should-Cost is the realm of the possible and Will-Cost is the domain of the probable. Neither is an absolute and the journey of discovery is what is truly important and valuable, for the journey produces analyses that assist both government and industry; government by using results of Should-Cost/Will-Cost management to help control cost growth and industry by using results to become and stay more competitive.