VALUE IMPROVING PRACTICES (VIP's)

Introduction

On every project, a formal Value Management Plan shall be implemented. The primary objectives of this plan will be:

- To identify and remove unnecessary capital, operating and maintenance costs
- To produce designs that will fully meet the environmental and regulatory requirements
- To achieve the lowest possible project costs (including life cycle cost considerations)
- To apply Best Business Practices enabling best-in-class performance
- To maximize the inherent value to the project

This plan will cover all the twelve (12) Value Improving Practices (VIP's) listed by Independent Project Analysis Inc. (IPA). VIP's are techniques and tools aimed at elimination of waste, reduction of investment (ie. costs) and reduction of non-value added activities. They improve overall capital productivity and when done at the right time and with optimal effectiveness, they can be expected to reduce overall costs by at least 5 - 10% without compromising quality, safety, reliability and operability.

Two formal Value Management (VM) Workshop sessions will be executed – one during the Front End Loading (FEL-2) phase and the other early in the detailed design (FEL-3) phase of the project. These will be structured sessions facilitated by Value Management specialists. Value improvement ideas will be captured, ranked and identified for follow-up actions with the results formally recorded and monitored. Cost reductions in "real" dollar terms will be confirmed and trended into the project, as applicable.

The Hurdles

Alignment of all participants to common objectives has always been difficult as each group (and individual) sees things through their own perspectives and goals. But such alignment is absolutely crucial if any desired project-wide objectives are to be met.

Everyone has good ideas. Some of these may be great ideas with significant value in terms of cost savings potential. But ideas will remain just that if all the players affected cannot agree and align their thinking and commitment to bring these ideas to reality. If the Process group identifies some benefits to changing some basic design elements, but is done too late in the detailed design phase, then this opportunity will be lost. If Construction brings up an idea which will save time and money in field construction, and Engineering do not believe that such savings are either real or realistic or achievable. And if Engineering do not adjust their designs to incorporate this, then what chance will this happen? And vice-versa.

Similarly, if the Project Management team is strictly focused on lowest TIC and rigid cost control while the plant Operations and Maintenance people care only to increase costs for better life cycle costs and enhanced systems that will facilitate their work, through improved operability and maintainability, then what chance will decisions be made to achieve any cost reductions at the expense of providing lower than expected facilities to the other groups? These are the hurdles which must be overcome.

The application of the Value Improving Practices (VIP's) and the formal implementation of this Value Management Plan will be an important step to identify and record the value improvement initiatives, the cost saving potentials and to establish the order of magnitude of savings in question for each item. This way, the cost ramifications will be known to all to help in the decision-making process to determine their value and whether certain initiatives are to be pursued or not.

Furthermore, effective and timely implementation of the VIP's and the application of "lessons learned" from other projects will go a long way in addressing and controlling the cost avoidance issues. These include non-value added activities resulting from ineffective execution strategies, inadequate planning and resources, out-of-sequence works and unnecessary rework – all tending to increase the project costs. Cost avoidance should be a critical project variable which must be addressed.

Definitions of Value Improving Practices

Value Improving Practices (VIP's) are focused activities aimed at removing non-value adding investment from the project scope. Collectively, they are an organized approach to optimizing the installed and life-cycle cost of a plant or facility and to increasing productivity, safety and quality.

VIP's are techniques which are aimed at the elimination of waste, reduction of investment and reduction of activities that do not add value to the business drivers, for the project, thereby improving the overall capital productivity.

VIP's are tools used in conjunction with a philosophy to ensure that capital spending will be optimized to meet the business and project needs. Exploration of strategies to avoid unnecessary capital expenditures becomes an integral part of the engineering front end loading (FEL) design phase.

Examples of such strategies to avoid capital expenditure include:

- Eliminating the source of waste instead of building facilities to treat the waste
- Emphasizing safety through training and accountability instead of fully automating the process operation
- Increasing yield and up time to expand capacity where possible instead of building new plants
- Buying ingredients instead of making them
- Buying services instead of providing them in-house
- Leasing the chemicals and equipment
- Having suppliers maintain backup equipment and parts instead of buying and maintaining spares
- Having contractors supply the services for non-core aspects of processes

When capital expenditure is the preferred alternative, the project will consider the following in the designs:

- Use vendor standard hardware
- Employ less redundancy and fewer backup systems
- Design facilities with less space
- Localized MCC's next to the equipment
- Put valves and instruments in most convenient construction location
- Utilize fewer permanent operating and maintenance platforms
- Build fewer operating and maintenance shops, or more spartan buildings
- Use more industry standard designs and specifications
- Avoid too much flexibility

VIP's will increase the value of designed facilities by reducing the non-critical scope items, increasing reliability, simplifying the process, improving the technology and hardware, and facilitating the project execution.

There are twelve (12) categories of value improving practices listed by Independent Projects Analysis Inc. (IPA). Typically, a process type project employs only 24% of the VIP's. For utilities and off-sites type work, this drops to only 22%. So there is room to make significant improvements in project execution over the industry norm. These VIP's are industry standard best practices benchmarked by IPA for Owner facilities to track their performance and progress against.

The following seven (7) VIP's are process related ones which shall be thoroughly implemented early in the process design phase:

1. **Technology Selection**

   A formal, systematic process to assess whether the technology selected is the best one over all the options available, ie. the most competitive available technology.

2. **Process Simplification**

   A disciplined, analytical method for reduction of investment costs (and often operating costs as well) by combining or making unnecessary one or more chemical or physical process steps. It is generally applied at the 10-15% design complete phase and capital avoidance strategies include some of the following analyses:

   - Value Analysis
     What processes add value and which do not.
     - Eg. any hold-up or storage where no chemical or physical change occurs
     - Most material handling
     - Tasks that do (heating) and then undo (cooling), or let down, then pressurize

   - Quality and Yield Analysis
     Examines yield losses and product quality and what customers will buy.

   - Product Sequence/Transition Analysis
     Examines the suitability of the process for the mix of products produced. Includes:
     - Pattern Analysis – array and volumes of products produced
     - Inventory Analysis – type and suitability of inventory
     - Equipment Analysis – product life cycles and reliability
     - Cost/Time Analysis – avoidance of in-process storage, minimize cycle times and minimize flexibility

3. **Classes of Plant Quality**

   This practice establishes what level of quality the facility needs to be at to meet the business goals. It adjusts reliability, expandability, automation, life of the facility, expected stream factors, likelihood of expansion, production rate changes with time, production quality and product flexibility. The Classes of Plant Quality can be used to determine the needed design allowance redundancy, sparing philosophy and room for expansion.

4. **Design to Capacity**

Often, equipment is designed with a "safety factor" to allow for additional durations or some future production increases (pre-investments). Designing to capacity requires the evaluation of the maximum capacity of each major piece of equipment. Design capacity can then be limited to just the needed capacity without the added cost for the "safety factor".

5. **Waste Minimization**

A process stream-by-stream analysis is made to develop concepts and proposals to reduce, or better yet, eliminate each non-useful stream. This analysis is made before the project scope is firm.

6. **Process Reliability Modeling**

The use of computer simulation of processes to explore the relationship between the maximum production rates and design and operational factors such as quality, yield, production transitions, maintenance practices and requirements, capacity, safety, environmental, and regulatory concerns.

This modeling is used to determine the most economical sizing, spacing and storage conditions which will meet the operability goals while minimizing cost.

7. **Energy Optimization**

The objective of this practice is to identify the most economical level of heat recovery and power generation and consumption. This is accomplished by optimizing capital and operating costs and operability of a process unit or utility system through thermodynamic analysis, economic analysis of furnaces and heat recovery equipment, and establishing the energy target that corresponds to the optimized cost. Life cycle costs are also optimized by examining power and heating requirements for particular processes.

The next two (2) VIP's involve the Owner's Operations, Maintenance, Safety and Construction personnel to agree on standards and design parameters to be followed:

8. **Appropriate Standards and Specifications**

Engineering standards and specifications can affect fabrication efficiency, product quality, operating costs and employee safety. However, sometimes the cost of a facility is increased by the application of codes, standards and specifications that exceed the actual needs of the facility being designed. Costs can also be inflated by insistence on unique company standards when acceptable industry standards exist. "Fit for purpose" specifications and standards shall be prepared eliminating specific requirements (referred to as "gold plating") that exceed the actual need of the facility being designed.

9. **Predictive Maintenance**

An approach to maintaining the plant whereby any equipment with moving parts are monitored and repairs effected as indicated before failure. Predictive maintenance makes use of advances in sensor and instrumentation technology to monitor characteristics such as heat, lubrication, vibration, cracking, noise and presence of corrosive products, and consistently incorporates them into the project design.

The last three (3) VIP's of the Plan include:

10. **Traditional Value Engineering (VE)**

A disciplined method used during design, often involving the use of an internal or external Value Management (VM) consultant, is aimed at eliminating or modifying items that do not add value to meeting the business drivers. This process will identify "discretionary elements" (hardware, materials, procedures etc.) which may be eliminated or modified without affecting the project objective and on improving life cycle costs.

- Ensuring client objectives are met by the design
- Identifying and removing items that add cost without contributing to function (ie. value)
- Studying the total cost of owning, operating and maintaining a facility versus renting or outsourcing a service or product
- Performing an analysis that defines a function, establishes a monetary worth for that function, and then provides the function at the lowest TIC (total installed cost)

11. Constructability Review

The key approach to constructability is not only the review of design drawings. It is also the early integration of Construction input into the planning, design and engineering processes. Construction input during project planning will:

- Allow system turnover requirements and construction needs to drive the overall project schedule from back to front
- Ensure plot plan layouts facilitate the space needed for construction execution strategies
- Make constructability an integral part of the project execution plans
- Actively include construction knowledge in project planning
- Obtain construction's essential involvement when developing contracting strategies
- Provide consideration for previously proven construction methods in basic design approaches, like modular construction concepts
- Apply Construction "lessons learned" from previous projects affecting engineering designs
- Promote efficient construction operation and maintenance through effective site layouts
- Input to ensure effective modularization execution and timing

This will positively influence cost reduction through:

- Designs configured to enable efficient construction and start-up
- Standardize design elements to enhance constructability
- Engineering and Procurement schedules that support the Construction schedule
- Development of modularization and pre-assembly plans that facilitate fabrication, transport and installation
- Design that facilitates construction under adverse weather or site conditions
- Reduced start-up and commissioning durations

12. Use of 3D CADD

Extensive use of 3D Computer Aided Design (CAD) will be done during the preliminary design and detailed engineering phases. The objective is to model the project in the computer to reduce the frequency of dimensional errors and spatial conflicts (both aboveground and underground) that cause design changes during construction. Clash check detection will be used to ensure proper installation of piping, structural steel, cable trays and underground systems.

The use of 3D CAD also improves visualization both for operations input and training and for construction in the field installations.

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Implementation Strategy

It is very important that all the value improving practices be effectively implemented on the project to achieve the best results possible. The benefits can be significant. All VIP's will be formally applied, structured, thoroughly executed and be scheduled and documented. All viable value improvement initiatives will be actioned and taken to their final resolutions and be implemented and recorded into the project design and execution, as warranted.

The attached Figure A shows generally when the various VIP's are to be applied during the life cycle of the project for the optimal results.

Two Value Management Workshops shall be held, and they should be externally facilitated by Value Management (VM) consultants, or internally facilitated, with the appropriate expertise. The first one will have a distinct process focus, as the value improving ideas related to the process design will be addressed. This will be done during the Design Basis Memorandum phase or FEL-2 per IPA definition. Specifically, the seven (7) process related VIP's are:

- Technology Selection
- Process Simplification
- Classes of Plant Quality
- Design to Capacity
- Waste Minimization
- Process Reliability Modeling
- Energy Optimization

The second VM workshop shall focus on Value Engineering possibilities during the Engineering Design Specification (EDS) phase, or IPA FEL-3, after the process designs have been frozen. Applications of lessons learned will also be implemented in this session.

- Traditional Value Engineering

Buy-in of the following VIP's applicable to the Owner’s operations, maintenance, safety and construction personnel will be confirmed for "fit-for-purpose" designs during this workshop:

- Appropriate Specifications and Standards (ideally, done during DBM or FEL-2)
- Predictive Maintenance

Early constructability involvement and reviews will be implemented at the initial design phase to assess impacts to the plot plan and construction strategies. Construction lessons learned and a formal constructability review will be conducted early in the EDS or FEL-3 phase.

- Constructability Reviews

Finally, the application of 3D modeling is a standard work procedure used extensively on all projects.

- Use of 3D CADD

These value management initiatives have been proven on projects in achieving cost effective and "fit-for-purpose" designs arising from the implementation of real and pragmatic value improving ideas. These projects have realized significant cost reductions in the 10 – 15% range and yet met all the quality, safety, reliability and operability objectives.

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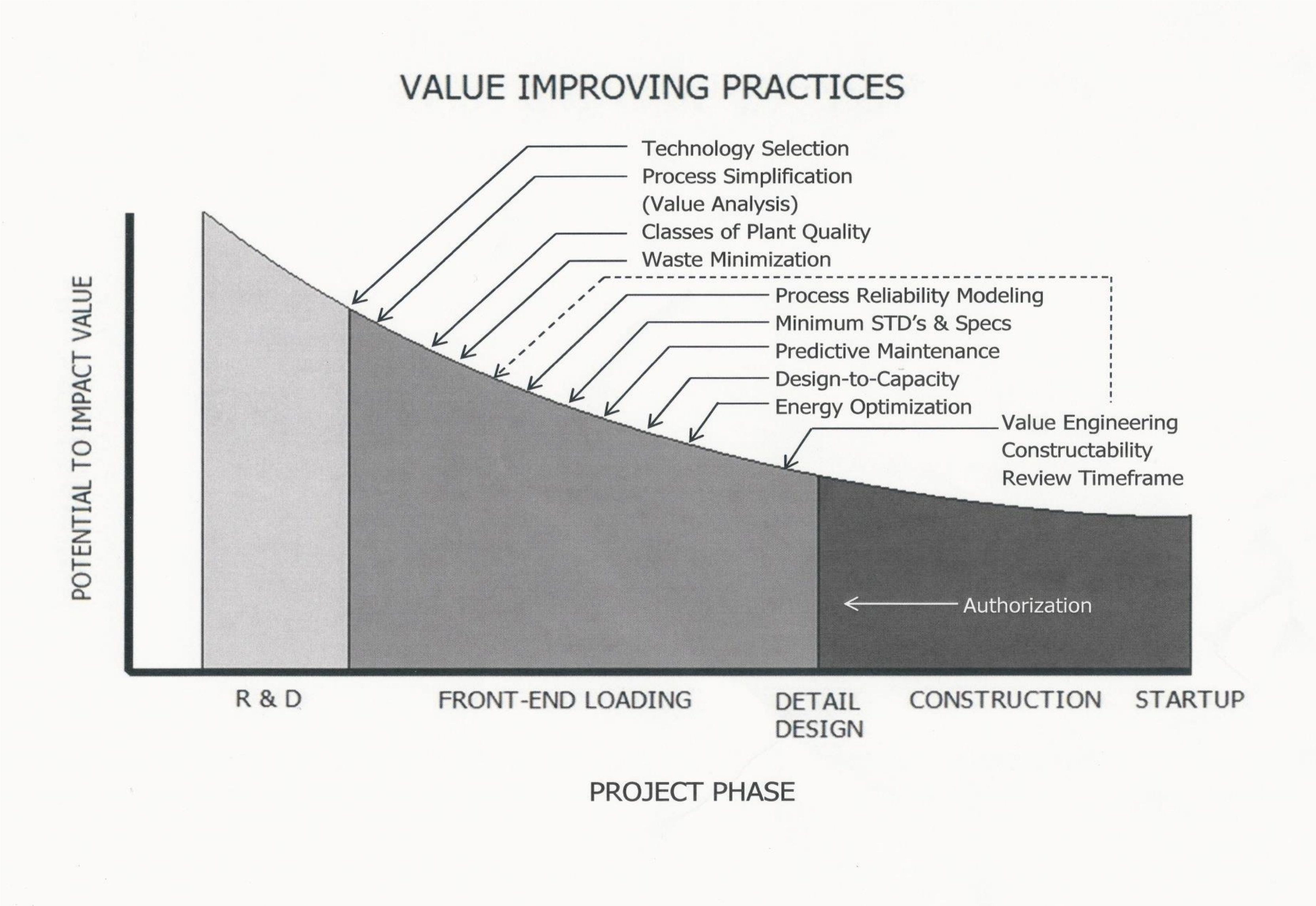
VALUE IMPROVING PRACTICES
Technology Selection
Process Simplification
(Value Analysis)
Classes of Plant Quality
Waste Minimization
Process Reliability Modeling
Minimum STD's & Specs
Predictive Maintenance
Design-to-Capacity
Energy Optimization
Value Engineering
Constructability
Review Timeframe
POTENTIAL TO IMPACT VALUE
Authorization
R & D
FRONT-END LOADING
DETAIL DESIGN
CONSTRUCTION
STARTUP
PROJECT PHASE