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INCREASING VALUE OF CAPITAL PROJECTS THROUGH COMBINATION OF CONVERGING AND DIVERGING VALUE EXERCISES

Garance Bundel and Marc Maeseele

Abstract

Within Shell there is a drive for increased capital effectiveness. To improve the capital effectiveness it is crucial to assess the project value at several milestones during its development. At these milestones key decisions are made based on the health of the project. On the one hand these key decisions comprise of whether or not it is the right time to develop a project looking at both the market conditions and inter-company competing projects. On the other hand the assessment is made whether or not the project is developed in the right way, by challenging the project (content) deliverables. The company focus is to do the right projects at the right time. The way to increase the capital effectiveness without jeopardizing operational performance is translated in a series of Value Processes. These are applied during the various phases of project development & implementation. The key goal of these Value Processes is having the right stakeholders involved to challenge and improve the opportunity and make key decisions. The Value Processes are available in a workshop format and allow input from a multidisciplinary platform. There are thirteen Value Processes that are mandatory for capital investments. For each project the capital expenditure and project complexity (e.g. technology and location factor) is used as input to determine the Value Processes that need to be applied. External benchmarking confirms that, on top of appropriate project development, the application of Value Processes is a key driver to good project performance. Projects where they have been applied experienced a significant project value increase (e.g. capital savings). The Value Processes that will be described in this paper are Design Class, Value Engineering and Assurance Availability and Reliability modeling. Design Class has a converging approach, while Value Engineering has a diverging approach to the opportunity. Through Assurance Availability and Reliability modeling a logical model is developed that simulates the performance of the chosen hardware scope to check its consistency with the premised targets.

In this paper the aim is to give a high level overview of how projects are done within Shell, and how the Value Processes fit in the project development. The three processes mentioned above

will be treated in more detail, due to the inherent different approach they have to the opportunity. This difference in approach results in a powerful source of value, when these processes are combined.

Developing Projects

The project development and implementation process consists of distinct but seamlessly linked project phases. In the project cycle, up to start-up, we consider the Identify phase, the Assess phase, the Select phase, the Define phase and the Implement phase (figure 1). At the end of each project phase, the project health is assessed and key decisions are made. On the one hand these key decisions comprise of whether or not it is the right time to develop a certain project looking at both the market conditions and inter-company competing projects. On the other hand the assessment is made whether or not the project is developed in the right way, by challenging the project (content) deliverables.

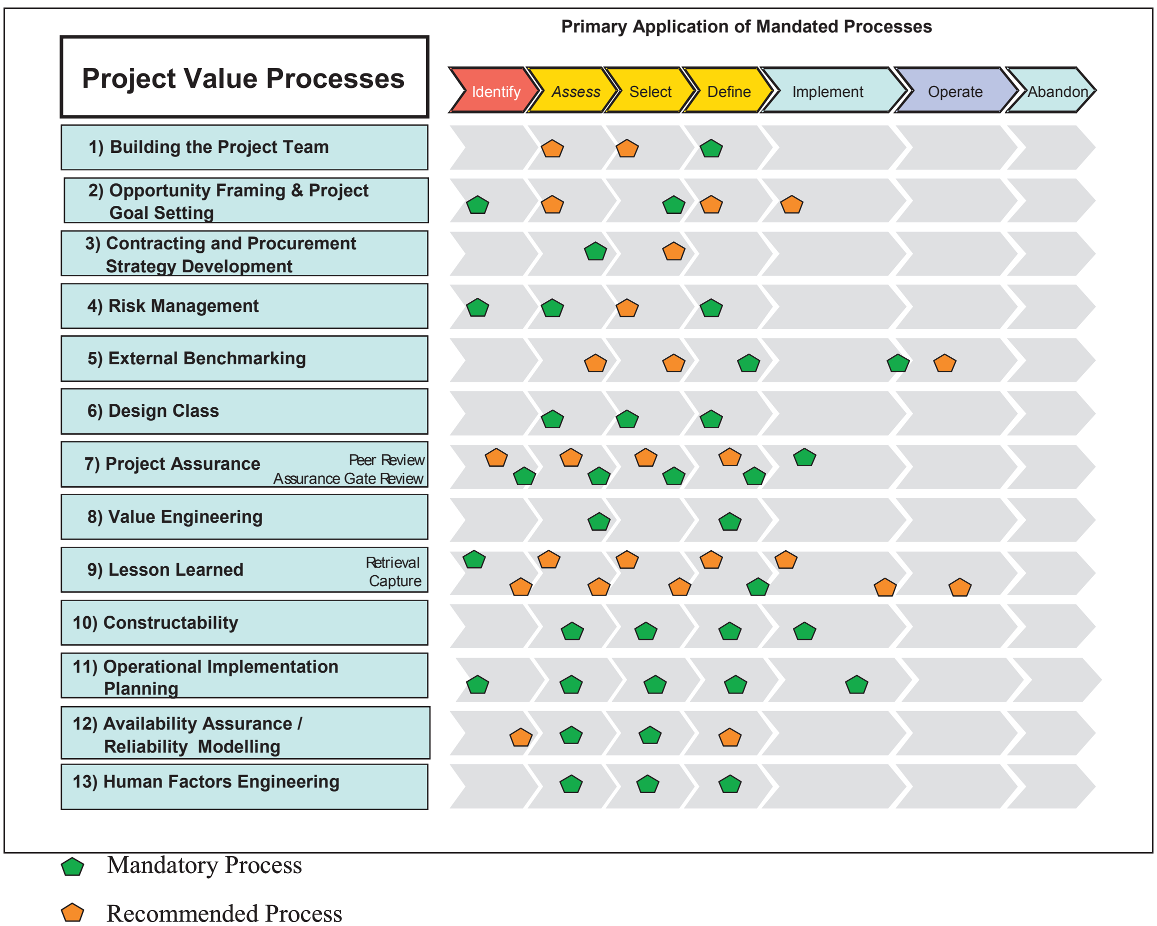
The way to increase the capital effectiveness without jeopardizing operational performance is translated in a series of Value Processes. Project Value Processes are processes put in place to maximize the project value, through creating a platform where different disciplines come together to challenge the opportunity and to determine the best way forward. Based on project size and complexity the required Value Processes are agreed between the Project Manager and the Assurance Manager. The Assurance Manager is responsible for monitoring that projects are developed in the right manner and that the necessary Value Processes are applied. The 'product' resulting from the application should be viewed as an 'agreement' (the Project Assurance Plan) between those parties that were actively engaged in executing these Value Processes. This agreement complements or refines the already agreed scope, objectives and plans for the project into a more detailed and precise description or definition.

Figure 1 shows an overview of the thirteen Value Processes. The thirteen processes provide a wide scale of tools for challenging the opportunity. The figure also shows at which project stages these processes are applied. The colors of the symbols determine whether or not the application is mandated or recommended (Green Symbol = mandated workshop or focused meeting; Orange Symbol = recommended or optional workshop).

The first Value Process (figure 1) helps to establish the project team and opens discussion of availability of both internal and external resources. In an early stage in the project an opportunity framing (process 2) workshop helps the business and project team to determine their objective and the development plan necessary to take the project forward. This exercise sets the business boundaries around the opportunity and creates the framework for developing the project. The third Value Process generates a Contracting and Procurement Strategy to gain the best commercial terms to improve our leverage in the supply market (contractors, equipment, materials etc). Through Risk Management workshops (process 4) the risks relevant to the project are identified and mitigation plans are generated. With lessons learned workshops (process 9) the knowledge from previous projects is implemented in an early stage. Implementing lessons learned from other projects is key for company success, as it stimulates a continuous improvement among projects. The Constructability workshop (process 10) is to ensure that construction considerations are identified and properly incorporated throughout the full course of a project. Operational and Implementation Planning (process 11) is a process to ensure smooth transition from construction to operation. Human Factors Engineering (13) helps project teams to Integrate human capabilities in the design of products and working environment. Through external benchmarking (process 5) we compare a project's performance against industries' best to identify those areas we have to improve to become or stay competitive. Project Assurance (process 7) is an external (but internal Shell) challenge, testing the project's robustness and maturity to allow progression to the next project lifecycle.

In this paper the focus will be on the process of applying Design Class (process 6), Value Engineering (process 8) and Assurance Availability and Reliability Modeling (process 12). Furthermore the added value of applying these processes in combination will be emphasized.

Figure 1. Overview of project phases and Value Processes



Format of applying Value Processes

Most of the Value Processes are applied in the format of a facilitated workshop. The Value Process facilitator and Project Manager start off the application of the Value Process with a First Contact Meeting. In this meeting the workshop/opportunity objectives are confirmed. The scope and market challenges are discussed and the business context is determined. The workshop participants are selected based on the influence they have on the opportunity and the impact the outcome of the opportunity has on them. The representation of the disciplines will be different dependent on the level of detail that the workshop will focus on. A typical workshop group comprises of the following representatives: Venture Manager/Business representatives (responsible for developing the right project); Project Manager (responsible for developing the project right), Process Engineer/Technologist (responsible for the technical contents), Operations (will own the asset).

Converging Design Class: Where the wants and the needs meet the capital

Design Class embodies a structured decision making process which is used to effectively establish and manage hardware scope and details for new operating facilities. The process supports communication and understanding the project's premises through a dialog on major hardware decisions, and subsequent engineering details. When used as part of the project development process, new plants can be built to meet the business strategies at the lowest possible costs and shortest schedule. When selecting classes for the design, three classes of plants are recognized. A Class 1 plant meets the business and project requirements with the minimum amount of hardware and equipment without jeopardizing safety. As a result of the simplified scope, the plant's cost is lower than that of the other classes. A Class 2 plant is a Class 1 plant that has been selectively upgraded to provide a higher level of assurance that off-design conditions will be met for some specific cases. Selected streams and systems may include additional pieces of equipment, increased complexity and/or greater engineering allowances to assure that they meet the business requirements. A Class 3 plant meets all of the business and project requirements for the selected design conditions and most off-design operating modes. More of the mechanical equipment and systems are spared to ensure that the plant is able to meet all of the premises essentially all of the time. The cost of this plant is higher than the other classes because of the increase in scope. The project engineering and construction schedule may be longer.

Application in Shell: How, when and why

Prior to the Design Class workshop the facilitator and project manager agree on the workshop objectives and the workshop attendees. These stakeholders that attend the Design Class workshop are mostly representatives from project management, business, operations and discipline engineering. As preparation for the workshop the facilitator and process engineers determine the high-level scope breakdown that will be treated during the workshop (figure 2).

The workshop is started with a grounding presentation that aligns all participants on the project status. The next step is for the workshop participants to agree on the performance deliverables of the plant (e.g. capacity range, capacity utilization factor, expandability of the design after implementation). During the workshop for each section (from the scope breakdown) a Design Class is selected. Selecting classes based on a high level scope breakdown limits risk of neglecting parts of the project scope through zooming in sufficiently. Additionally it gives a better insight on where the capital should be spent and where it can be saved. During the workshop the team discusses the classes of the plant required based on the expected level of plant performance. In Design Class tables it is accurately described which hardware requirements are linked to the selection of a Design Class. These tables are used to guide the discussion among the stakeholders. The tables describing the general hardware requirements (e.g. sparing philosophy, the design allowance in equipments) are used during the Assess phase. During the Select phase more detailed tables are used, that describe the hardware requirements on equipment level.

After the workshop the outcome is included in the project development. The discipline engineers have the lead in improving the tables content and their applicability (based on the lessons learned from the workshop). Figure 2 gives an overview of the Design Class Process.

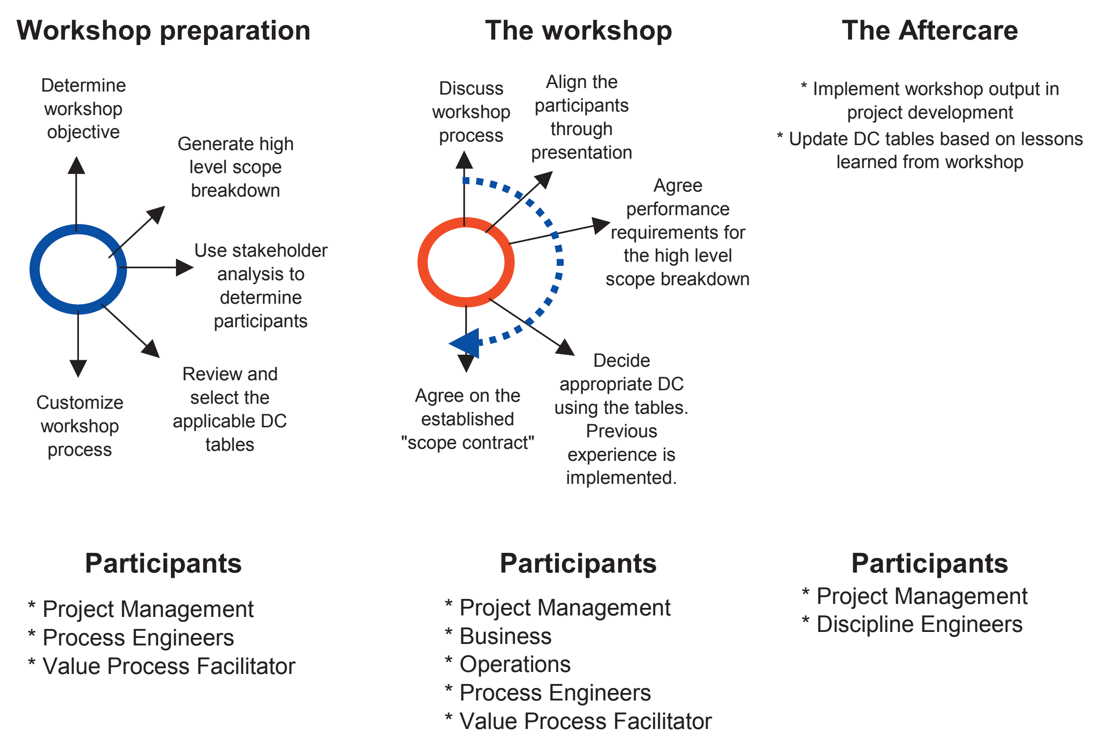


Figure 2. Design Class (DC) Overview

During the Assess phase the Design Classes of the plant are selected in accordance with the type of facilities that the customer (Operations) requires. In addition, this phase delivers a list of 'big ticket items', being items that (may) have a large impact on the project's scope, timing and capital expenditure estimate. The purpose is to develop an understanding of the priorities and requirements for the project from a business prospective. It also serves as input for the development of the capital expenditure estimate and the execution strategy of the project. The result sets the tone for the project.

In the Select phase the Design Class selection done during the Assess phase is revisited to ensure that this is still in line with customer expectations and business requirements. The selected classes are further developed into design and engineering definitions on the basis of the Design Class Detailed Tables. During the Select phase the list of big-ticket items identified in the previous phase is reviewed to arrive at a decision-making strategy for these items. The purpose of this work is to get the project team and engineering contractors engaged in a dialogue on Design Class interpretation and to understand the main criteria and potential risks of the project. The intent is to have a decision making process regarding the selection of detailed plant design issues, involving all relevant stakeholders.

In the Define phase the design aspects of the big-ticket items are included in the main deliverables resulting from the previous phase. The purpose of sharing Design Class selection and interpretation with engineering contractors is to ensure a proper understanding of the project scope and selected design and engineering solutions, and to generate a dialogue that may cause improvements or efficiencies of the proposal.

The concept of selecting appropriate Design Classes for a project, and the subsequent translation into design and engineering solutions, supports the process of creating a fit-for-purpose facility for the minimum amount of investment.

Diverging Value Engineering: Approaching the opportunity with an open mind

In Design Class the structured approach aims to determine the investment necessary to build and operate the plant optimally without over-design. The selected class generates the framework along which the plant should be built. This framework indicates the expected performance of the hardware after implementation. What Design Class does not generate is the selection of hardware or processes necessary to obtain the functions that need to be established in the design. This is where Value Engineering comes in. Within the framework established by the Design Class, different hardware/process alternatives are established to meet the performance targets. Although Value Engineering may be commonly equated to cost reduction, the thrust of Value Engineering is to maximize life cycle value by optimizing capital cost in conjunction with operating and maintenance costs and revenue. The strategy of considering the complete lifecycle value of a capital investment can, through Value Engineering, lead to the choice of increasing capital in order to decrease the operational expenditures after implementation.

Application in Shell: How, when and why

Prior to the workshop the key hardware functions are mapped by the Process Engineers, Project Manager and Value Process Facilitator. This map is used to brainstorm alternatives for the existing scope. The participants that are invited to the workshop are selected in a way that the available knowledge and expertise during the workshop is maximized. Usually project management, business, operations and the discipline engineering are present during the workshops. In most cases field experts are invited to help generate process/engineering alternatives. If an engineering contractor has been selected they can also be invited to help generate new ideas. For each of the functions the multidisciplinary team brainstorms alternatives. The alternatives are prioritized looking at the project value they generate and the applicability in the project looking at the phase the project is in. Ideas that cannot be implemented due to the development stage are considered for implementation in less mature projects. All high ranked ideas are allocated to a custodian responsible for its development and implementation in the project. Figure 3 gives an overview of the Value Engineering Process.

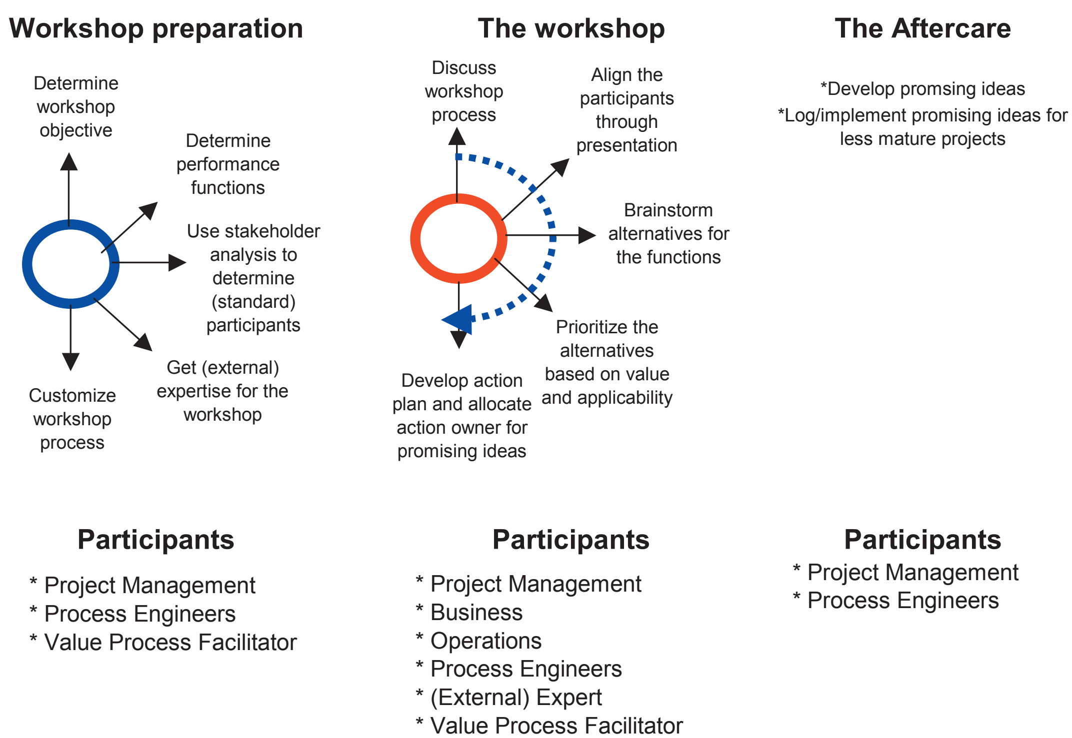


Figure 3. Value Engineering Process

Value Engineering is applied through different phases of project development. As the project matures the focus of the Value Engineering studies will shift. During the Identify phase and early Assess phase (figure 1), Value Engineering can be used to improve opportunity economics and assist in technology selection. In late Assess phase the focus changes to Process Simplification. Finally in the Define phase the focus shifts to engineering design and operability. In Process Simplification the focus is to optimize project value by challenging business premises, addressing operating philosophy and exploring alternative process design options. The term "Process Simplification" is consistent with the terminology widely used in the chemical and refining industry. The focus of this exercise is wider than just a simplification of the process, as in some cases, alternative designs of higher complexity, such as heat integration, may be considered if they enhance overall value on a life-cycle basis.

Assurance Availability & Reliability Modeling

Do we get what we aim for?

Design Class and Value Engineering give project teams the opportunity to determine the appropriate scope of projects. In order to forecast whether or not the designed hardware will achieve the performance objective, Assurance Availability and Reliability Modeling (AA/RM) is done. This Value Process is an important link in this triangle (figure 4) as it proves that the frame work established through Design Class selection and the function analysis as done in Value Engineering meet the stated business and operational objectives. During a project's development, the project team discusses the details around the plant's process design, equipment connectivity, equipment selection and inherent reliability. A mathematical model is developed to describe the proposed plant.

Application in Shell: How, when and why

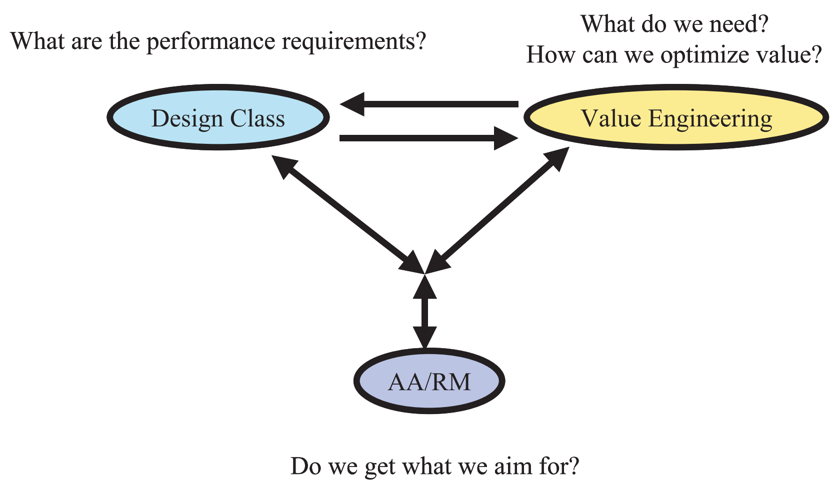


Figure 4. Continuous interaction between the Value Processes

During the Identify phase, the project stakeholders provide the initial project premises that document the target capacity utilization of the facility. The process engineer assigned to the project kicks off the AA/RM Value Process once the process configuration for major equipment is understood. The process engineer and AA/RM specialist will define the requirements for this high level model. As the project moves forward to the Assess and Select phase, the reliability model developed during the Identify phase is enhanced with more details. After the Identify phase the AA/RM group is expanded and a study team is formed. The typical AA/RM study team includes a project engineer, a process engineer, an AA/RM Value Process specialist, an AA/RM data specialist, a site operations representative, a site maintenance representative, and a location reliability engineer. Other disciplines are invited to join the AA/RM study team on an as-needed basis. This multi-disciplinary platform allows input to the model from the whole life cycle of the project. As the project matures the reliability model is updated and enhanced with process design development, with specific equipment sizing and selection, and with updated equipment reliability data. Based on the model the AA/RM specialist makes recommendations for any changes on the equipment types and sizes. This equipment data is then further developed and included in the project cost estimate.

Convergence, Divergence and the test

The three Value Processes described above focus on different levels of value creation during the development of the project (see Figure 5). The difference in value added by the processes is driven by the difference in converging and diverging approach to the opportunity. With convergence the boundaries around the opportunity are established, while the diverging approach helps project teams to assess options fully to obtain the hardware performance objective required during operations. The first Design Class workshop helps to determine the hardware performance requirements of the opportunity. Alternatives are explored within the framework that improve the project value through Value Engineering workshops. The hardware necessary to meet the required performance is established. Through Assurance Availability modelling the actual performance is calculated.

This sequence is repeated during the subsequent project phases but based on more detailed scope. Applying this combination of Value Processes has shown significant potential capital savings within Shell. Timing of application of these processes is crucial for obtaining the maximum value. Design Class workshops are held before the Value Engineering workshop, because it determines the degrees of freedom available. Assurance Availability modelling is done when sufficient knowledge is available about the hardware that is to be implemented.

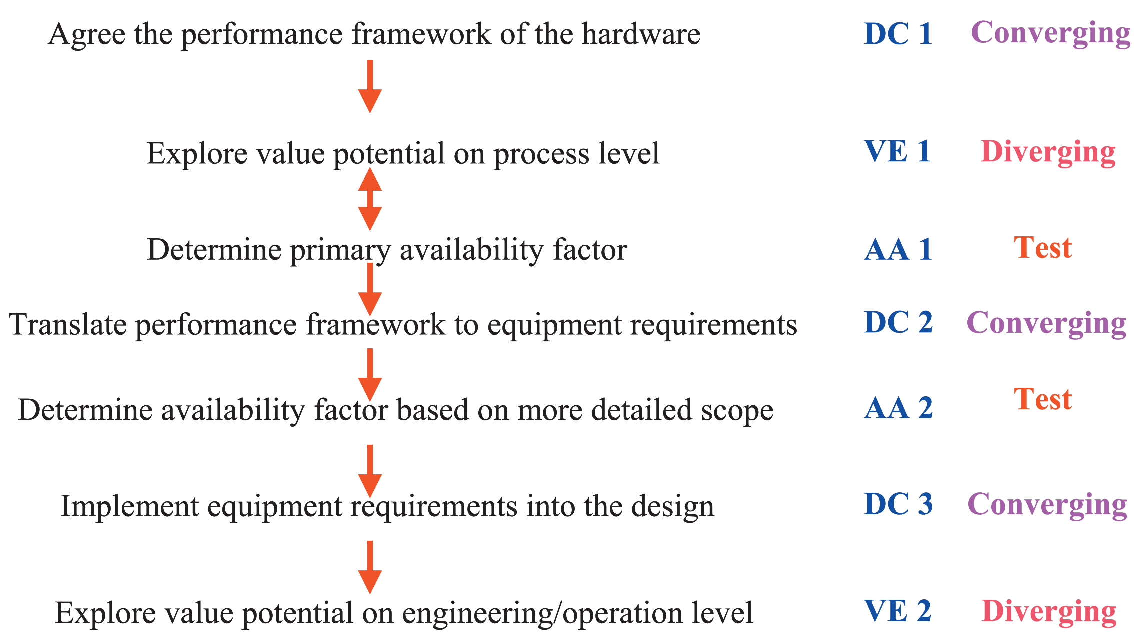


Figure 5. The converging and diverging approach of Value Processes

Conclusion

Within Shell's stage gate project approach there are thirteen Value Processes in place that are applied in different project phases as pre-determined through a Project Assurance Plan. Experience has shown that applying these Value Processes appropriately will add significant value to projects. Three Value Processes that have been discussed here are Design Class, Value Engineering and Assurance Availability Modelling. These three processes have been chosen because of the different approach in assessing the opportunity. Design Class stimulates convergence while Value Engineering stimulates divergence. It is the tension between these processes that generate the discussion platform between commercial and engineering disciplines. These multi-disciplinary discussions facilitate project value maximization. Through Assurance Availability and Reliability Modeling the performance of the chosen hardware scope is simulated to check its consistency with the premised targets for its performance. Multiple application of the Value Processes in the different project phases helps to take into account the additional project and hardware knowledge obtained as the project matures. The result of applying these processes, apart from creating value leads to alignment and a common understanding of premises across various project stakeholders and across the different project phases. This in itself promotes clear decision-making and facilitates efficient project progress.

Author details

Garance Bundel, Msc.

As a chemical engineer Garance Bundel has been working in the Shell operational environment for 3 years. Currently Garance works as a Project Value Process Consultant within Shell Global Solutions. Here she spends 100% of her time advising Gas, Oil and Chemical projects on the implementation of the Shell Project Value Processes.

Marc Maeseele Msc, MBA

Graduated as materials engineer, Marc joined Shell in 1992 and spent 10 years in technical management roles in an international environment. During this time he co-authored a number of publications on Value Management. He obtained an MBA from IMD in 2002. He currently is Principal Consultant and global lead for Project Value Processes within Shell Global Solutions.

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