APEX: Agile Project Execution

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Customers have traditionally selected products based on their reliability and availability, and so Yokogawa has focused on delivering excellent hardware and software. In recent years, however, the efficiency during project execution and the usability and maintainability throughout the lifecycle have become equally important for customers, in terms of capital expenditure (CAPEX) and operating expense (OPEX), respectively.

Yokogawa has developed the APEX methodology by integrating a huge amount of knowledge accumulated through project execution (delivery excellence), cooperation with engineers worldwide (smart engineering), and advanced technologies incorporated in the CENTUM VP R6. This paper details a project execution methodology based on iterative engineering in APEX.

INTRODUCTION

As a top supplier of process automation, Yokogawa has been innovating its solutions, services, and products to meet the needs of customers including engineering companies (engineering, procurement, construction: EPC).

Conventionally, many plant owners seek to minimize capital expenditure (CAPEX) and leave the selection of process automation suppliers to an EPC. As a result, a supplier that submits the lowest bid for constructing a plant wins the project order. In recent years, however, plant owners place priority on optimizing process automation throughout the plant lifecycle, i.e., minimizing both CAPEX and operating expense (OPEX). Therefore, Yokogawa has worked with customers to create the concept of main automation contractor (MAC) to maximize value throughout the plant lifecycle.

This paper describes the agile project execution (APEX)[1] methodology. With this methodology, Yokogawa can provide value to both plant owners and EPCs when it undertakes a project through the conventional competitive bidding or as a MAC.

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Figure 1 shows the concept of APEX. APEX offers more value than ever through the optimum combination of a huge amount of knowledge accumulated in projects (delivery excellence), the best team of experts from each field (smart engineering), and the latest technology built into CENTUM VP R6.

Delivery excellence is based on best practices extracted from the experience Yokogawa has gained in various projects for refineries, petrochemical complexes, power plants, and other facilities around the world. Actual engineering based on these best practices (application software for control, etc.) is defined as the standardized design, put into a library (industry library), and reused globally. This standardized design is updated to reflect the latest findings. Such standardization reduces the need to customize engineering for each plant and simplifies the maintenance work throughout the plant lifecycle. Therefore, this approach is highly evaluated by customers.

Smart engineering provides the optimum, highly efficient service to customers through the global collaboration of experts from each field regardless of time difference and place. With this system, Yokogawa can respond to difficult requests from customers with advanced technical knowledge that it has accumulated. The centralization of engineering is expected to bring excellent cost effectiveness, and Yokogawa will expand this engineering strategy globally.

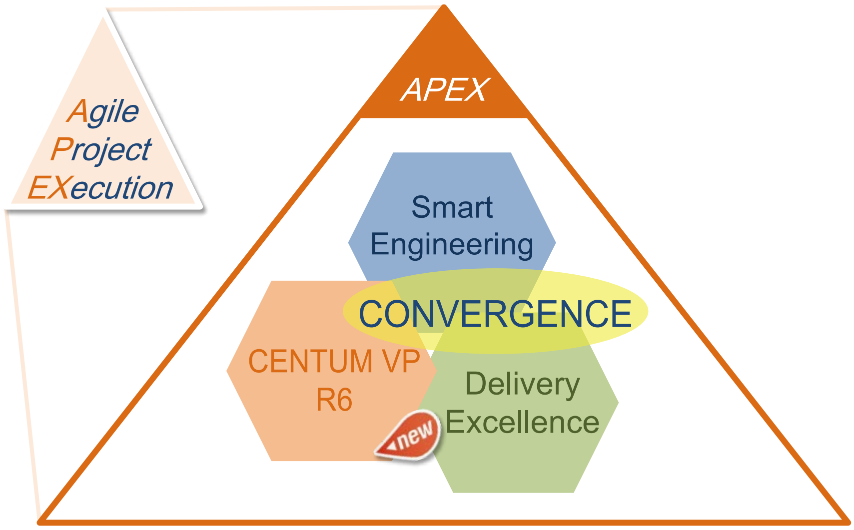

Figure 1 Concept of APEX

For CENTUM VP R6, Yokogawa developed AD Suite [(2)] as an engineering environment that can perform APEX most efficiently and effectively. In addition, the innovative technology of CENTUM VP R6 that combines AD Suite, N-IO (Network I/O), FieldMate Validator, and the PRM commissioning support package enables agile project execution, which is advocated in APEX.

APEX can be achieved by combining delivery excellence, smart engineering, and CENTUM VP R6. With the standardized design based on knowledge, it improves the efficiency and quality of design and offers expert knowledge and outstanding cost effectiveness, thus delivering excellent project execution services to customers.

AGILE PROJECT EXECUTION: REPEATABILITY AND FLEXIBILITY

Agile means "quick action," one element of the VigilantPlant [(3)] concept advocated by Yokogawa. It implies a project execution method that repeats short cycles of execution.

As process automation systems become ever larger and more complex, it is becoming increasingly difficult to finalize the requirements for plant construction projects. Specifications are changed at any time in a project. Yokogawa's project execution teams are required to flexibly deal with such changes while meeting the deadline and quality requirements. However, they often need to perform a huge amount of revisions manually.

In addition to the conventional waterfall type method, APEX has established an engineering process for repetitive implementation as an agile project execution. By repeating engineering processes, APEX deals with frequent changes and solves this problem. Iterative engineering is performed independently and repeatedly to create applications and arrange hardware input/outputs (I/O). A key for implementing this iterative engineering process is a mechanism that separates applications and hardware I/Os and performs respective engineering, as well as a mechanism for strict change management.

The iterative engineering in agile project execution and its advantages are described below.

CREATION OF MODULAR APPLICATIONS

In the conventional engineering for CENTUM, engineers use a setting tool called Builder to determine the configuration of hardware (controllers, I/O modules, channels, signals, etc.) and then create control applications based on the configuration. Each control application is usually created as a one-off to suit the requirements of each plant.

In a recent trend, however, NAMUR NE 148[(4)] and Industrie 4.0 [(5)] provide a method in which plant design is separated into physical modules of facilities and other units, and the whole plant is designed by combining these modules. Such a modular plant design is equivalent to design methods based on the hierarchical physical model in ISA88 and 95[(6)]. By applying modular design to the creation of not only physical modules but also control applications, the benefit of modularization can be maximized.

In the modular application creation method, engineering is standardized into modules, which are put into a library and used repeatedly with some limited parts customized. This method can maximize the advantages of the iterative engineering, which is shown in Figure 2.

By using the modular application creation method, customers can repeatedly use the industry library and unify the design of applications in all plants around the world. Since sharing the library ensures the consistency of the design policy, design errors and risks originating from the complexity of integration can be reduced. In addition, the application design can be maintained and managed in accordance with the unified policy, reducing total cost of ownership (TCO), including OPEX.

EPC is pursuing the standardization of total package design to improve the efficiency of project execution. Total package design means to create a standardized design suited for the process license and its applications, to put them into a library, and to make them into a package with standardized processes from design, creation, and start-up to commissioning of a system. All processes of engineering can be left to a single team, which helps accumulate knowledge on basic design and engineering. In addition, standardized modules can minimize the influence of changes, reducing the period for plant design and retesting, and hence costs.

Yokogawa offers reusable industry libraries (for refineries, petrochemicals, LNG, batch, electric power, and other industries) based on plant standards such as ISA 88 and 95 or VGB-B 105 (KKS)[7] and abundant experience on project execution for various industries.

Although it is very effective in project execution to use a reusable industry library, some elements may have to be modified in accordance with elements in projects, such as plants, facilities, and system configuration, and their changes. Even in such a case, it is possible to meet requests for changes while minimizing the impact on other modules by identifying the affected modules and customizing them. Modularization can minimize the impact of changes, which is crucial to prevent reworking and retesting, especially in the late phases of a project.

To maintain and use modular design throughout the plant lifecycle, customers must strictly manage changes and quality in an integrated manner. AD Suite for CENTUM VP R6 is a powerful tool for automating these processes which were conventionally performed manually.

With AD Suite's innovative functions, customers can satisfy the requirement regarding modular engineering, which is a core of Industrie 4.0. The details of Industrie 4.0 are described in the NAMUR NE 148 and ZVEI White Paper, "Module-Based Production in the Process Industry"[8]. Figure 3 shows the automation configuration advocated in NAMUR NE 148. NE 148 notes that modules (within the dotted line of Figure 3) should be easily built in the design of a DCS. In this case, it is important that modules (instruments and units) can be freely connected, disconnected, and connected again with a control system. Actual technology to achieve NE 148 is under development by a NAMUR task working group (NAMUR AK1.12), which Yokogawa has also joined.

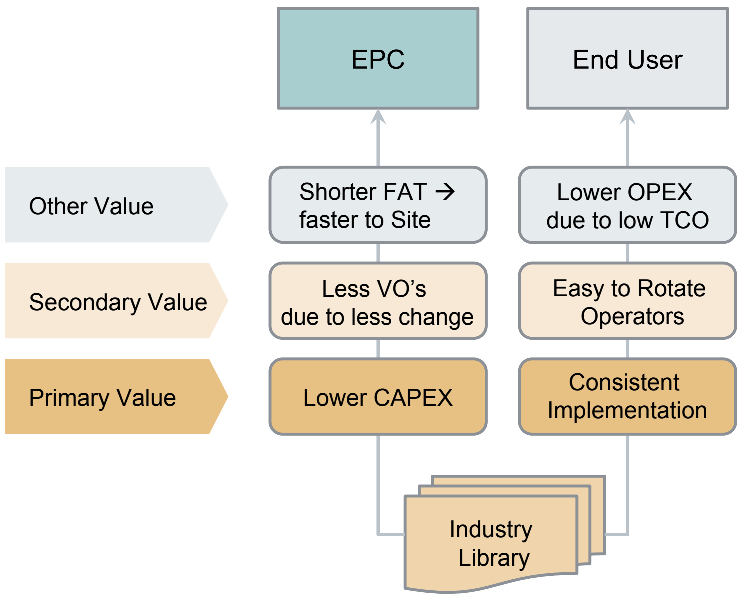

Figure 2 Benefits of creating modular applications

ARRANGEMENT OF ITERATIVE I/O

In recent years, the concept of late binding has become popular in the automation industry. Late binding means that the applications and hardware of DCS are configured independently and can be bound at any time. Late binding enables projects to be performed much more flexibly. Its advantages are outlined below.

Tasks that take time in project execution are the manufacturing and assembling of hardware cabinets, field wiring, and loop check. When dedicated I/Os are required for signals, changes in the late phases of a project may have a huge impact on the cabinet design and connection work, substantially reducing the advantages of late binding.

Yokogawa advocates the system free instrumentation (SFI)[9] approach that can be achieved by combining AD Suite, N-IO, FieldMate Validator and the PRM commissioning support package, which are all provided for CENTUM VP R6. In the SFI approach, standard N-IO smart junction boxes that can be distributed throughout the field play a key role in eliminating the work of designing hardware and reducing the amount of documentation. The SFI approach helps make full use of the advantages of iterative engineering in arranging I/Os. In the early stages of arranging iterative I/Os, the process can be carried out without needing to design a junction box by determining the type and number of standard N-IO smart junction boxes (16-point, 32-point or 64-point) to be installed in the field according to the approximate number of signals for each process area and system. Even if the actual number of signals differs from the estimation, redesign can be avoided by adding junction boxes or designating redundant boxes as spares. In addition, conventionally, it is necessary to rearrange I/Os and re-wire them when, for example, the signal type is changed from digital output (DO) to analog output (AO). In contrast, there is no need for such changes in the iterative I/O arrangement method that uses N-IOs. Therefore, the scope of the impact caused by changes can be minimized, and redesigning and retesting in the late phases of a project can also be reduced.

The iterative I/O arrangement method that makes full use of the SFI approach can improve the benefits of late binding.

INDEPENDENT, REPETITIVE CREATION OF APPLICATION AND ARRANGEMENT OF I/O

Performing iterative engineering for creating applications and arranging hardware I/Os independently is a key feature of agile project execution.

Conventionally, the applications of the process automation system are closely linked with field devices and hardware I/Os. Therefore, when the design of a control room and hardware is changed in the later phases of a project, this makes it necessary to change applications accordingly.

AD Suite can independently create applications and arrange hardware I/Os. By using logical I/O names, applications are independent of the physical arrangement of I/Os, and logical I/Os and physical I/Os are mapped in the final phase. Therefore, changes in physical I/Os do not affect the logical I/Os of applications, and similarly, changes in logical I/Os do not affect physical I/Os.

Since the progress and locations of each project execution do not affect each other, engineers dedicated for each project execution can proceed with iterative engineering.

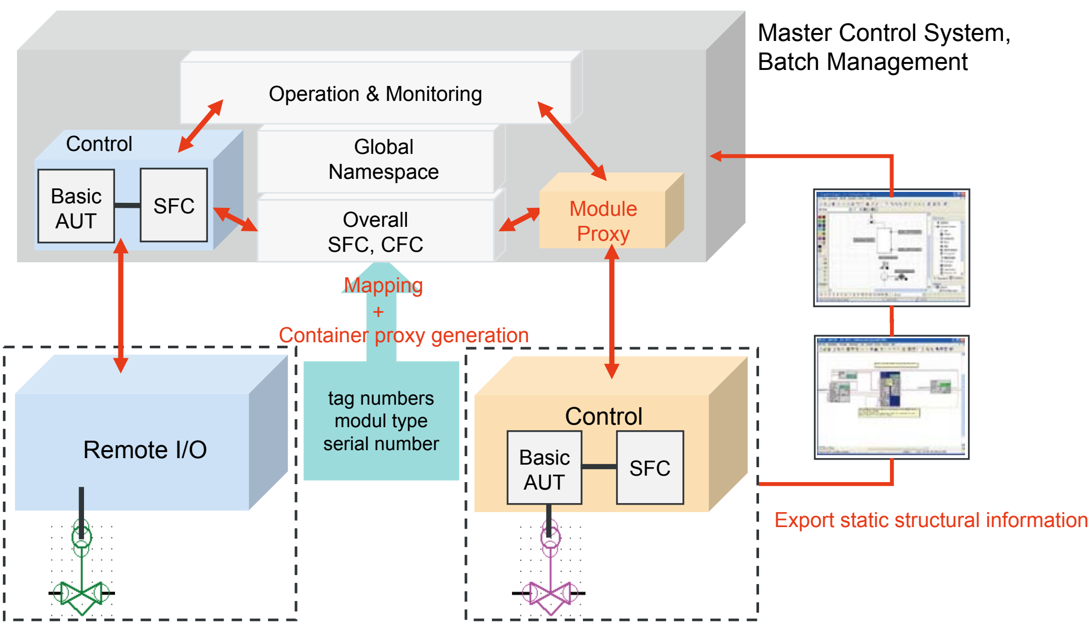

Figure 3 Automation structure required by Namur NE 148

CHANGE MANAGEMENT

Change management is one of the most critical tasks in project execution. It affects all areas of the process automation system, in particular: quality, schedule, and financial aspects of hardware, system, and applications. The importance of change management has increased for the iterative engineering described in this paper. This is because this type of engineering allows changes to be made at any time and therefore its project execution is difficult to manage compared with the waterfall type engineering in which each step starts only after all work has finished in the former process.

AD Suite has a built-in change management function. It deals with the ID, requester, description, method, and performer of changes, targets before and after changes, and the approval process. With this built-in function, users managed by AD Suite can be designated as a changer, and engineering targets and their change history can be linked to the change management function. Therefore, the change process is strictly managed; when a user designated as a changer logs onto AD Suite, he/she finds tasks allocated to them, performs changes in accordance with instructions, obtains approval in accordance with the approval process, and finishes the whole process. The change status and change history can be traced for each change ID.

CONCLUSION

This paper explained the agile project execution methodology, focusing on iterative engineering. Compared with conventional engineering, this engineering can deal with change requests while maintaining quality, schedule, and cost, thereby enabling final decisions to be delayed. In the plant lifecycle, this engineering helps expand, maintain, or improve process automation systems without affecting the consistency of design from the beginning.

Meanwhile, iterative engineering is a difficult method for project execution because it allows changes at any time. Generally, repeated changes lead to human error. To satisfy customers in terms of quality, delivery schedule, and cost, we must build a mechanism that prevents human error and fixes those that do occur. This is achieved by creating modular applications, arranging iterative I/Os, and strictly managing changes.

With AD Suite and N-IO, FieldMate Validator and the PRM commissioning support package, which are all released for CENTUM VP R6, and the engineering process that flexibly deals with changes by using them, Yokogawa will continue to reduce the TCO of plants which are becoming larger and more complex.

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