

Achieving Effective Technical Control

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Abstract:

In any project, complete, stable and validated requirements are essential to success. Once this objective is achieved, the Systems Engineer's focus must turn to achieving tight technical control to ensure that what the customer asked for is what the engineers deliver. This paper describes an industry-proven process of technical control that is integrated with cost and schedule control and leaves no doubt as to who is responsible for delivering a system that meets customer's requirements. This process also satisfies the requirements of the Earned Value Management criteria and activity based accounting principles.

Key Words: Technical control, WBS, activity based costing, design manager.

Acknowledgement:

Some of the diagrams presented in this paper have been developed under contract with the Defence Material Organisation (DMO), they appear with the kind permission of the Head of Electronic Systems Division, DMO.

Introduction

Many developmental projects focus attention on cost and schedule control only to find that without technical control the cost and schedule objectives cannot be achieved. In such projects, to achieve minimum risk, technical control must take primacy over cost and schedule control. The objectives of technical control are to ensure that the customer's technical requirements are satisfied, to have clear accountability for technical outcomes and to integrate technical control with cost and schedule control.

Technical Control Objectives

It will be assumed that the customer's requirements are complete, stable and validated and that all stakeholders have agreed these requirements. In a typical project the requirements are analysed, logical models are analysed and evaluated and specifications are produced for the system, subsystems and lower level products or components. This process is shown in Figure 1 below.

The time sequence of this process is from the top of the diagram to the bottom, that is the system level down to the subsystems and from the subsystems to the lower level components or products. If this diagram is turned on its side, as in Figure 2 the time sequence runs from left to right with the specifications being developed on the left side of the diagram and the products being developed on the right side of the diagram. System specifications are developed from user requirements; the subsystem specifications and their interface specifications are developed next followed by the component specifications and their interfaces. At all levels the specifications are traceable back to the user requirements.

Once the specification process is complete, components must be developed and verified against their specification and then integrated into subsystems in accordance with their interface specifications. Subsystems must be verified against their specification and integrated into the system in accordance with their interface specification.

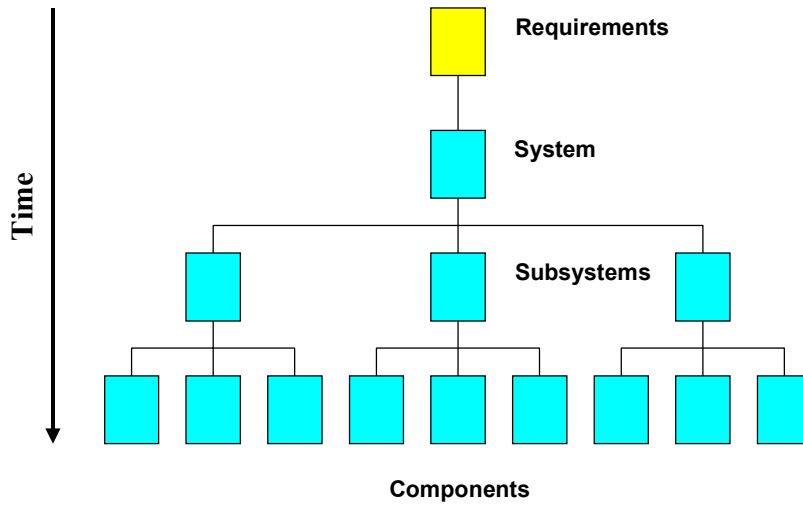


Figure 1: Systems Specification and Product Hierarchy

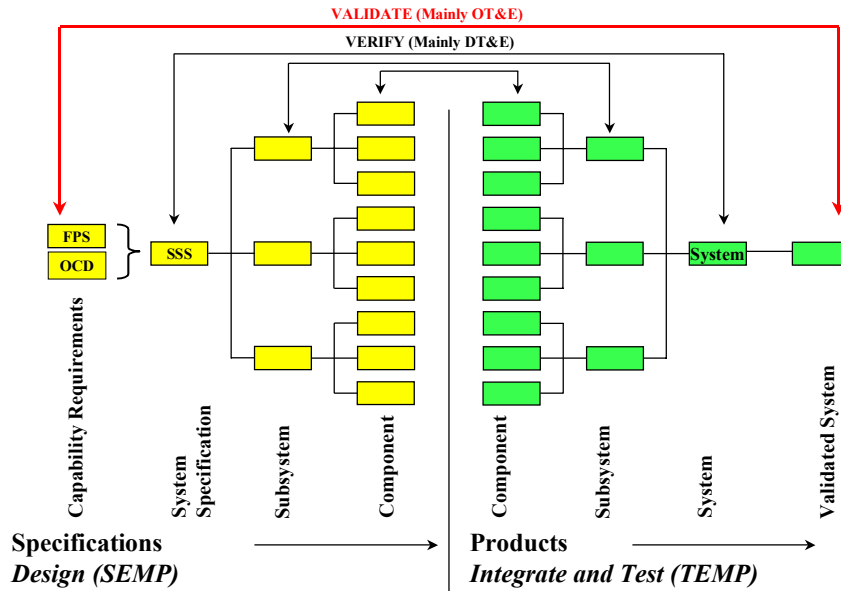


Figure 2: Technical Control Throughout The Project Lifecycle

Achieving Technical Control in Practice

The logic of technical control seems fairly obvious however it is often not achieved in practice due to unclear responsibilities and poor partitioning of the problem space. The first step in clarifying responsibilities is to appoint a Design Manager for the system and then subsequently for each product in the product hierarchy and to make that Design Manager responsible for delivering a product meeting its specification. The system Design Manager is then responsible for decomposing the specification for their system into specifications for the subsystems and the subsystem interface specifications. The system Design Manager then guarantees that if the subsystems meet their specification and are connected as specified in the interface specifications then the system will meet its specification. This responsibility is shown diagrammatically in Figure 3 below.

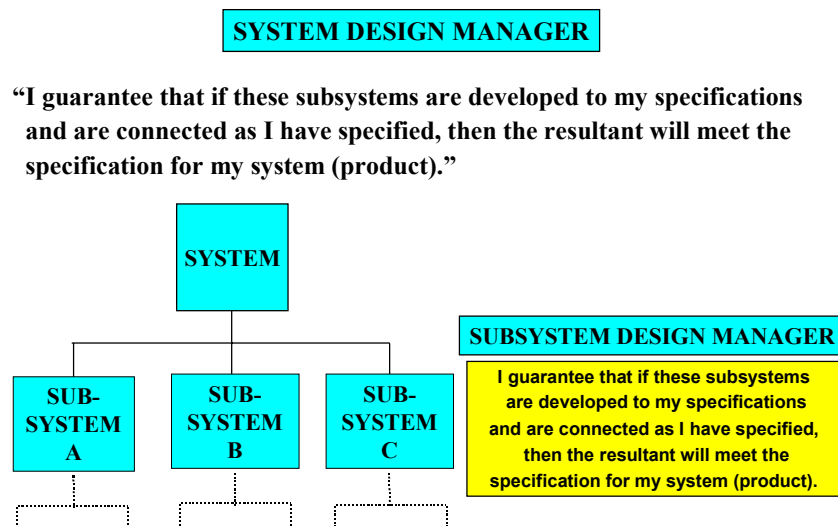


Figure 3: Responsibility of the Design Manager

The responsibility of the Design Manager is applied repeatedly down the entire product structure and leaves no room to ‘pass the buck’ or for anything to ‘slip between the cracks’. If any item does not meet its specification then there is no doubt as to who is responsible.

Cost Attribution

Achieving technical control in isolation will not satisfy project management and accounting requirements. Activity based costing principles and Earned Value Management criteria both require that all costs associated with the development of a product or service must be attributed to that product or service. The recursive process of decomposing a product to its lower level sub-products, including cost attribution, is illustrated in Figure 4 below.

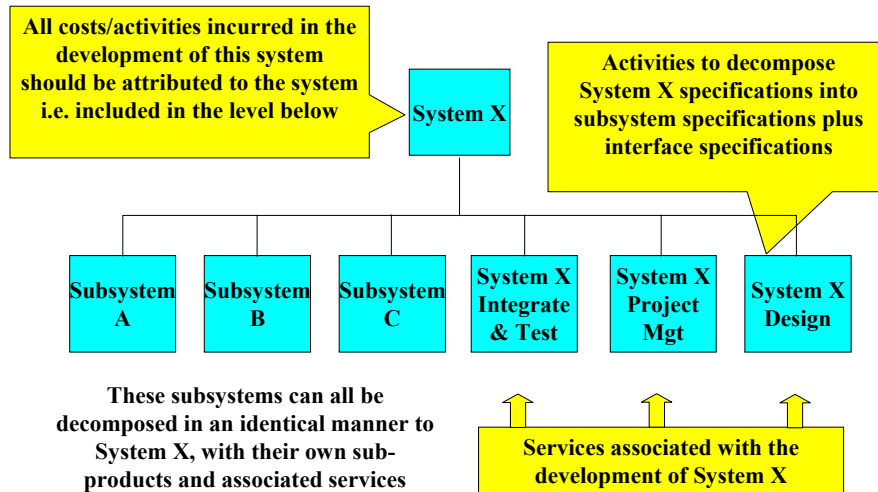


Figure 4: Cost Attribution For Recursive Product Decomposition

This cost attribution requirement forces the systems engineering associated with the decomposition of the product and the integration and test of the product into the level below the product in the Work Breakdown Structure (WBS).

Integration of Technical Control with Cost and Schedule Control

Technical control is based on having a specification tree in which all products are visible and have specifications traceable back to the customer's requirements. These products form the kernel of the product structured WBS and by satisfying the cost attribution requirements, the specifications map to products that then map to costs and schedules. Figure 5 below illustrates the mapping of specifications to products in the WBS and then to control accounts or work packages in a cost and schedule control system. It is important to note that a WBS element must have an associated WBS dictionary definition that is effectively a Statement of Work (SOW) for that WBS element.

Each product WBS element has an associated specification, a SOW in the form of the WBS dictionary, budget and schedule. This process will endow the WBS element with the key attributes of a subcontract and hence facilitates the management and accountability for the development of the element.

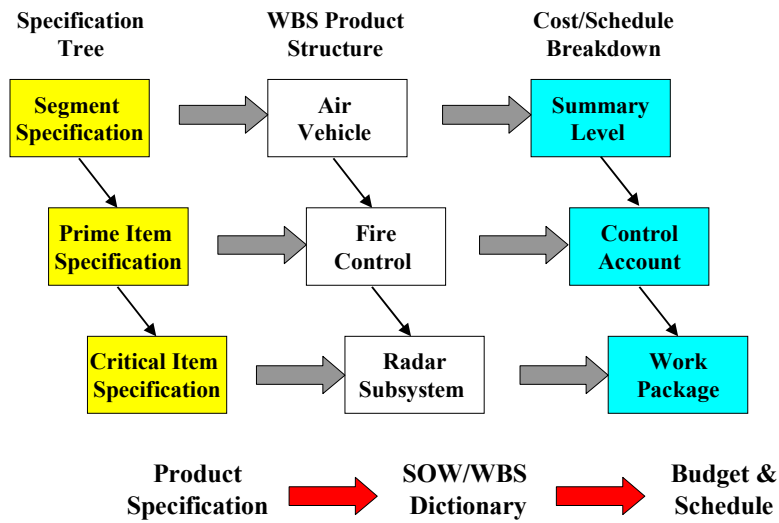


Figure 5: Integration of Technical Control With Cost and Schedule Control

Figure 6 below illustrates the subcontract characteristics of WBS elements developed in accordance with the method described.

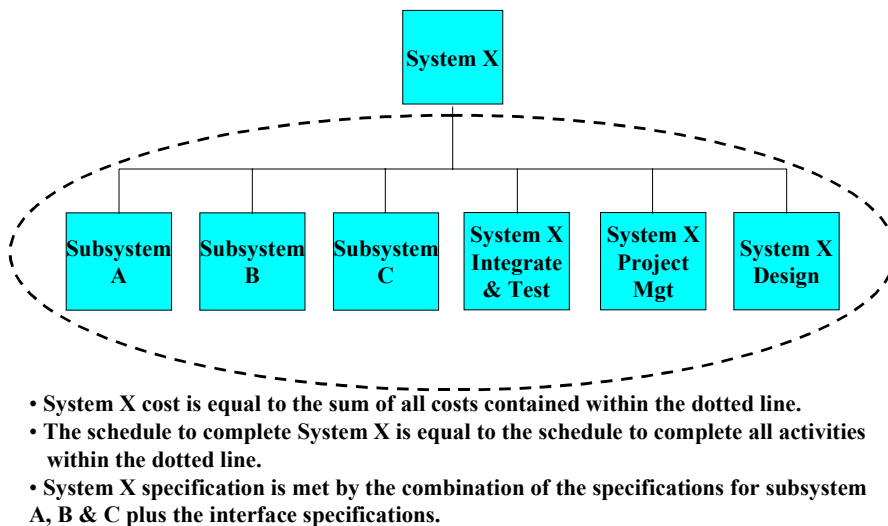


Figure 6: WBS Elements as Subcontracts

Relationship of Design Manager to Project Manager

One of the key factors in achieving effective technical control is the appointment of the Design Manager for each product in the product hierarchy. Although some management standards identify the one person as being responsible for the delivery of a product meeting specification within the agreed budget and schedule, in practice the highly specialised technical skills and the managerial skills often do not reside in the same person.

In any large project there is usually a project manager who is responsible for the programmatic aspects of the project and there is a systems engineering manager (or some other technically competent authority) who is responsible for the technical aspects of the project. This relationship can in practice be applied repeatedly to each of the products in the product structure. Figure 7 below illustrates the recursive application of this principle.

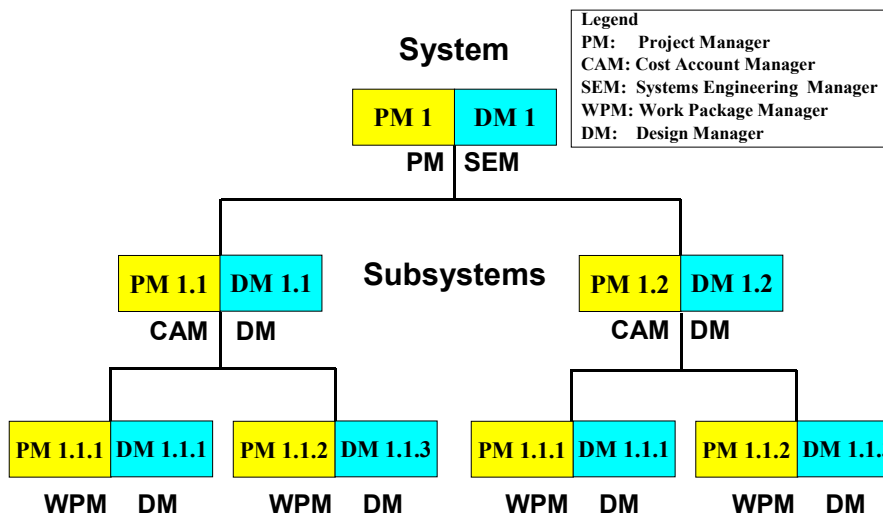


Figure 7: Relationship of Design Manager To Project Manager

Conclusion:

Effective technical control can be achieved whilst satisfying project management and accounting objective by the process of:

1. Having a product structured WBS in which all product specifications are traceable to the customer's requirements via the specification tree.
2. Assigning a Design Manager for each product in the product hierarchy with clear technical responsibility for the delivery of that product meeting specification.
3. Endowing the product WBS elements with the attributes of a subcontract by making the products in the product hierarchy work packages in the cost and schedule control system.