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The Application of Systems Engineering to Project Management

A Review of Their Relationship

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ABSTRACT

This study investigated the application of systems engineering to project management. There is an increasing complexity to modern projects, and lifecycle-focused project management displays the inability to manage the risks associated with increased project complexity. A more adequate approach to these issues is presented in the systems engineering processes. It was proposed that the application of systems engineering concepts will allow improve the management of complex projects and the mitigation of risks. Additionally, qualitative research conducted via the collection and analysis of credible information yielded data that supported this proposition. Since systems engineering processes are adaptable, they are suited to manage complex problems. It was concluded that applying systems engineering to project management was beneficial, and the integration of methodologies was valuable to the successful completion of large scale, complex projects.

KEYWORDS

Project Management, Projects, Systems Engineering, Systems Thinking

INTRODUCTION

Background

The use of projects and project management as a means to add value to an organization was proven essential to the growth and development of modern industry. To improve operations, to react to opportunity, and to manage the challenges that arise within a business environment, projects are required. Contrary to processes or operations, projects are unique and must be treated individually. While no two projects are the same, they share a set of properties that qualify them as such. There are specified objectives, durations, budgets, and general constraints that all projects have. Projects are multifunctional, spanning across numerous industries, sectors, or departments and the use of both human and nonhuman resources are required. One of the most defining properties of a project is that it has defined start and end dates, so it is always finite. Projects can be considered as temporary endeavors that offer unique solutions. Also, it should be noted that there are many differences between projects and processes. Repetitive or ongoing activities that utilize well-established systems and practices would be the definition of processes. Furthermore, there is a high certainty of success and a low risk of failure when performing processes. While processes serve to support the status quo, projects tend to violate established practices and upset the status quo. Although higher risk is

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associated with projects than processes, projects tend to yield greater rewards (Pinto, 2019; Ahern, Leavy, & Byrne, 2014; Badi & Pryke, 2016; Azar, 2012).

A necessary tool to mitigate risk and to ensure that a project is completed to specification within its constraints is project management. By dividing a project into smaller, more manageable tasks and subtasks, project managers can maintain a higher level of control over their projects. By recognizing that all projects have finite life cycles, this can be achieved. Furthermore, there are four main points to a project lifecycle. The initial phase of the project lifecycle is the conceptualization phase. During this phase, the initial goals and specifications of a project are developed. Project scope begins to take shape, and key stakeholders are recognized at this stage. The conceptualization phase is then followed by a planning phase. During planning, specifications become more detailed, and project scope becomes better defined. To develop planning documents, such as schedule, budget, and schematics, these elements can be used. After the completion of planning, project execution can begin. The execution phase sees project-related work being performed and completed. Once work is completed, the project termination phase is initialized. During the termination phase, final products are transferred to the customer or stakeholders, and resources can be reassigned. Essentially, the termination phase is completed with the closing of a project. The aspects of a project life cycle provide abilities that are vital for project control. Also, the waypoints by which project completion can be measured are lifecycle stages. There is also a means for visualizing the activities required for project completions provided by life cycle aspects, as well as some of the challenges that a given project may face (Pinto, 2019; Al-Kadeem, et al., 2017a; Eskerod & Blichfeldt, 2005; Zelinka & Amadei, 2019).

Primarily, there are many shortcomings attributed to traditional project management. The ability to track and maintain a pre-specified duration and budget is one of the most important aspects of project management. In projects today, increased rates of project failure are commonly derived from cost overruns and delays. Also, consistency between tasks and/or whole projects is lacking in projects. It is being shown that the current practices of project management are becoming less able to manage project risks. At the core of these notable deficiencies is the inability to manage increased complexity. To deal with the risks associated with increased complexity, a new approach to project management should be taken, as modern projects are growing larger and more complex. The field of project management has the potential to make improvements to its practices: enter the field of systems engineering.

An interdisciplinary approach to the realization of successful systems is referred to by the term "systems engineering". To clearly define customer requirements early in development and to proceed with the design and validation of systems is the focus of systems engineering. Meanwhile, the overarching problem that is to be solved is always considered. It is stated by The International Council on Systems Engineering (INCOSE) that:

Systems Engineering integrates all the disciplines and specialty groups into a team effort, forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs. (INCOSE, 2018)

In attempting to understand the field of systems engineering, it is crucial to first understand systems. A system has been defined by a consensus of INCOSE Fellows as a construct or collection of different elements that produce unobtainable results by the elements alone. From numerous different disciplines and resources from people to facilities, software, and documents, systems utilize certain elements. To add value that is greater than the value of its individual parts to business and technical fields alike, a system provides its service. The benefit of utilizing systems to achieve goals is that systems level results can be expected, such as control functions, performance, behavior, and quality. Moreover, there is adaptability and comprehensibility to systems.

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