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## Identifying and measuring project complexity

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### Abstract

This study provides a constructive approach to identify and assess project complexity as a separate factor influencing projects. Project complexity was described in terms of managing projects rather than project physical features to ensure the research results can be generalized across different industries. The complexity attributes and indicators deemed to measure those associated attributes were developed. The data collected through a survey was analyzed using statistical methods to test the significance of complexity indicators in differentiating low complexity projects from high complexity projects. The data analysis resulted in 37 complexity indicators associated with 23 attributes statistically significant to project complexity. The research findings help scholars and practitioners in the project management field in developing an appropriate strategy to manage project complexity effectively.

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### 1. Instruction

Project complexity is frequently perceived as a factor imbedded in two major project aspects including project difficulty (how hard the project is to achieve project objectives) and project risks (uncertainties). These two major factors largely influence how a project is managed and executed. However, project difficulty is basically related to project team's expertise and experience, and project risks are used to describe the unknown features of project.

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Whereas, project complexity is generated from known factors that can have additional impacts on projects. Additionally, project complexity typically begets project difficulty, which in turn makes the project harder to complete and requires special effort to keep project risks in check. It is important to acknowledge that difficult project objectives, such as a compressed construction schedule or critical resource shortages, may actually cause a project team to choose methods that are more complex to achieve aggressive project goals. At this point complexity and risk are observed to diverge; that is, the project team can purposely increase the complexity of a project in the form of re-sequenced work, alternate partnerships, different procurement strategies, multi-sourcing of materials, and increased staff or craft levels with little to no impact to the overall project risk profile. Increased complexity is managed by maintaining positive control of new project interfaces. In fact, some risks can be mitigated as a result of the more complex approach. Since complexity and risk can track independent of each other, they can only be categorized as two different properties within a project.

It is necessary to study complexity as a separate factor influencing projects. This includes a need to define project complexity, study the individual and most important attributes of complexity, and identify the indicators that truly reflect complexity of a project. Most attributes of complexity are known to be constantly changing variables such as project type, project size, project location, project team experience, interfaces within a project, logistics/market conditions, geo-political and social issues, and permitting and approvals. Better understanding of project complexity in any phase of the project development process and creating a strategy to manage complexity, influences how efficiently and economically projects are planned, managed, executed.

## 2. Literature Review

Complexity theory generally defines what a complex system is within a specific area of interest (e.g., natural, biology, eco-system, computer science, human society, or financial market, etc.) and studies the interaction between the elements in that system. The existing theoretical issue of complexity theory is that there is still no commonly accepted definition of complexity, despite there being a large number proposed [2]. As defined by Valle [8], a complex system is a whole that consists of several elements interacting with each other in many different ways. Numerous interdependent elements in a complex system continuously interact and spontaneously organize and reorganize themselves into increasingly elaborate structures over time.

Scholars have focused on the identification of complexity attributes more than any other topic in the field of project complexity. Studies in this area have evolved significantly over the past twenty years. Cicmil et al. [5] identified complexity as a factor that helps determine planning and control practices, hinders the identification of goals and objectives, or a factor that influences time, cost, and quality of a project. Baccarini [1] identified two major attributes of complexity: 1) organizational complexity; and 2) technical complexity. Organizational complexity reflects the view that a project is a task containing many interdependent elements. Technical complexity deals with complexity related to the transformation processes, which convert inputs into outputs. Gidado [7] defined project complexity and identified the factors that influence its effect on project success. Also, the study proposes an approach that measures the complexity of the production process in construction

Global Alliance for Project Performance Standards (GAPPS) [6] developed a project manager standard in 2007. As a major section of the project performance standard, GAPPS developed a comprehensive project management complexity measurement tool called CIFTER. The Crawford-Ishikura Factor Table for Evaluating Roles (CIFTER) provides a seven-factor model from which project management complexity of projects is assessed. A total project complexity score is created by adding the scores from all seven factors outlined in the CIFTER. The total CIFTER score is used to categorize each project as either below Global Level 1 (scores less than 12), Global Level 1 (scores 12 to 18) or Global Level 2 (score 19 or more). Each of the seven factors in the CIFTER is rated on a point scale of one to four with the total number of points across the seven factors determining whether a project is Global 1, Global 2, or neither.

Generally, several definitions of complexity were found from a wide range of disciplines. However, there is still no widely accepted definition of project complexity used by complexity scholars. While a fair number of papers and books were found around different methods of measuring complexity, it seems that very few scholars have studied project complexity as a separate factor influencing project characteristics in the project management field. A detailed

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