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Project complexity assessment and management tool

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Abstract

Project Complexity Assessment and Management (PCAM) Tool was developed to help project teams identify, assess, and manage project complexity. This Excel-based tool was designed with a "Complexity Measurement Matrix" comprising of the indicators that are statistically significant to project complexity. The weight factors of these complexity indicators were developed based on the expert ranking result from a subject matter workshop. These factors function as the multipliers to place greater emphasis on the stronger complexity indicators. The comprehensive reports from the tool present the overall project complexity level, a series of radar diagrams describing the most important indicators, and associated management strategies. The outputs help project teams formulate a management plan for the most important contributors with sufficient flexibility to be deployed at multiple project stages and for different project sizes.

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1. Instruction

Project engineering researches often study complexity as one of many variables. Most of these studies focus on the theoretical background of the topic and describe a broad definition of project complexity. Cicmil et al. [4] 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. There is a crucial need of

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integrated complexity studies in order to identify, assess, and manage the complexity of a project and an efficient complexity tool to help project practitioners facilitate this process. One of the downsides of the completed studies was that while significant number of studies that assess complexity, there is no integrated study that defines the project complexity, introduces its attributes, and proposes a methodology to measure the level of complexity of each project.

For the topic of project complexity, scholars have focused on the identification of complexity attributes more than any other aspects. Studies in this area have evolved significantly over the past twenty years. Baccarini [1] identified two major attributes of complexity including organizational complexity and 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. Generally, the number of project components, degree of activeness within each component, degree of interactions between project components, and interactions of the project with entities outside of the project were frequently considered as the attributes that create complexity of a project.

Global Alliance for Project Performance Standards [5] developed a project manager standard in 2007 with a comprehensive project management complexity measurement tool called CIFTER (Crawford-Ishikura Factor Table for Evaluating Roles). The tool provides a seven factor model on which the project management complexity of projects can be assessed. Lebcir and Choudrie [6] introduced four driving factors of project complexity based on previous studies: infrastructure size, infrastructure interconnectivity, infrastructure newness, and project uncertainty. The impact of these factors on the project life cycle has been modeled using system dynamic method. Vidal et al. [7] developed a method to measure the complexity level of a project using Delphi and Analytic Hierarchy Process (AHP) methods. The authors have identified seventy possible complexity factors. Then, using the Delphi method, 18 essential factors have been selected as the most influential factors on project complexity.

The PCAM tool presented in this paper was developed on the basis of a complexity measurement matrix comprising of the complexity indicators that have been proven significant to project complexity. The measures of complexity were developed based on the data set collected from the historical projects. The importance of each complexity factors on the overall complexity level of a project was allocated based on the expert ranking results. A project team can use PCAM Tool to assess the current complexity level of project at a particular point in the project life cycle. The tool can be used for different phases of a project and for any industry projects including industrial, infrastructure, or buildings with different project sizes.

2. Project Complexity Measures for PCAM Tool

One research supported by Construction Industry Institute has identified the complexity attributes and indicators deemed to measure the associated attributes. The statistical analysis of this research finally resulted in 37 significant indicators measuring 23 associated complexity attributes. Table 1 presents two sample category of the significant complexity attribute and indicator. These 37 complexity indicators were statistically significant in differentiating low complexity projects from high complexity projects. These indicators were used as the input for PCAM Tool.

3. Complexity Indicator Measurement Scales

The PCAM Tool was designed with a Complexity Measurement Matrix comprised of 37 complexity indicators each with a 3x3 measurement scale with separate low, medium, and high measurement ranges. These measurement scales were generated by normalizing the factual data collected from the past projects on each complexity indicator. The survey data collected for each indicator was used as a basis for setting the nine-point range. Typically, the mean from the survey data for the indicator was used to set the medium score (4-6). The low range from the survey data was used to set the low score (1-3) and the high range from the actual survey data was used to set the high score (7-9). When a complexity score for an indicator is assessed depending on the impact level of that indicator on the project, a numeric score from 1 to 9 is assigned to each measurement range with 1 being lowest through 9 being highest score (i.e., most complex). The complexity scores of each indicator function as the complexity-impact level of that indicator to the project.

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