



Clarifying the project complexity construct: Past, present and future

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Abstract

The research explores the historical development of project complexity. Projects are becoming more complex due to unexpected emergent behaviour and characteristics. Complexity has become an inseparable aspect of systems and also one of the important factors in the failure of projects. While much has been written about project complexity, there is still a lack of understanding of what constitutes project complexity. This research includes a systematic literature review to demonstrate the current understanding of commonalities and differences in the existing research. This was achieved by examining more than 420 published research papers, drawn from an original group of approximately 10,000, based on citations during the period of 1990–2015. As a result of this exploration, an integrative systemic framework is presented to demonstrate understanding of project complexity.

It was found that there are three primary and distinctive models of project complexity, the Project Management Institute view, the System of Systems view and the view developed from the analysis of citations of research papers, which is called the Complexity Theories view. Further testing is required on a range of complex projects in order to attempt to reconcile these views.

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1. Introduction

Complexity is one of the most important and controversial topics in project management. It is controversial because some organisations, such as the Project management Institute (PMI), a leading body in the area, has a very different view of complexity by comparison with the System of Systems (SoS) view, which is employed on most major defence and health projects in the western world. Varying degrees of complexity exist in all types of projects. This is evident in the early definition of complexity as an entity consisting of many varied interrelated parts and elements such as tasks, components, and

interdependence (Hornby and Wehmeier, 1995). Thus, every project contains a degree of complexity. However, there is no universally accepted definition of complexity (Ireland, 2013). At the same time, Stephen Hawking (2000) observed about the 21st century, it “will be the century of complexity”. Similarly, Project Management Institute (PMI) noted that “complexity is not going away and will only increase. However, based on PMI’s version of complexity, they state that ultimately, how organisations anticipate, comprehend and navigate complexity determines their successes and failures” (PMI, 2013, p. 5). Complex systems display a variety of behaviours, including self-organisation, emergent properties and non-linear behaviour, and are often counter-intuitive. As a consequence, opportunities for external or top-down control are very limited (Helbing, 2013). Given that numerous interactions are undertaken and project components do not follow simple causal relationships, complexity can be viewed as “the inability to predict the behaviour of a system due to large numbers of

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constituent parts within the system and dense relationships among them” (Sheard and Adviser-Mostashari, 2012, p. 11).

Although extensive research on project complexity exists, there is no conceptual definition agreed upon among researchers. In addition, insufficient research is available so far about the examination of the diverse perspectives on the subject in the project management literature, including SoS view, among others. The purpose of this paper is to clarify the understanding of project complexity and the implication of this definition for management of complex projects. The research seeks to answer the following questions:

- Q1. What characteristics comprise project complexity and how they have been developed?
- Q2. What factors contribute to project complexity considering the different schools of thought?

To answer the research questions, a systematic literature review has been conducted to define complexity in the context of project management. The analysis period is from 1990 to 2015 and covers key developments in project complexity (see Fig. 1). In addition, selected publications have been examined and are discussed in the paper. Finally, a project complexity framework is proposed, integrating three dominant perspectives, including the PMI view, the SoS view and the complexity theories view, developed from the large group of research papers examined.

As illustrated in Fig. 1, uncertainty and complexity concepts were introduced to project management literature around the year 1990. Analysis of selected publications in this paper covers 1990–2015. During 1990 to 1995 most studies were focused on the role of uncertainty and project structure in contributing to complexity in projects. The development of project management concepts was subsequently influenced by the advances in the domain of SoS between 1995 and 2000 and a new perspective of complexity was initiated by Maier in 1996, introducing four types

of SoS, these being directed, acknowledged, collaborative and virtual (Maier, 1996). Furthermore, the most notable research milestone between 2000 and 2005 was achieved by Snowden as he drew clear distinctions between simple, complicated, complex systems and chaotic systems (Snowden, 2002).

Studies demonstrate that the number of publications on complexity soared in years between 2005 and 2013, and a wide spectrum of views of project complexity emerged in this period. These views are further discussed in Section 3.2.

2. Defining complexity in the context of project management

Before examining project complexity, it is useful to look at projects as a hierarchy of simple, complicated, complex, and chaotic. According to the available literature, we can define simple projects as limited activities undertaken to create products or services with clear cause-and-effect relationships. This implies that each participant in a project can appropriately respond to different situations by accessing the necessary information, which in the realm of project management can be qualified as belonging to the domain of “known knowns,” where all operations are self-evident, predictable and repeatable. Preparing food and manufacturing simple house appliances or many constructions projects are usually good examples of simple projects. In complicated projects, there are cause-and-effect relationships between tasks and elements. Knowledge and expertise are essential for understanding complicated projects and eventually they require proper practices in order to overcome problems (Snowden and Boone, 2007). In other words, complicated projects contain subsets of simple projects but are not merely reducible to them. The nature of complicated projects is not always related to their scale, but to the issue of coordination or specialised expertise (Glouberman and Zimmerman, 2002). Sending a rocket to the moon, producing aircraft and most large construction projects are complicated and once completed a small

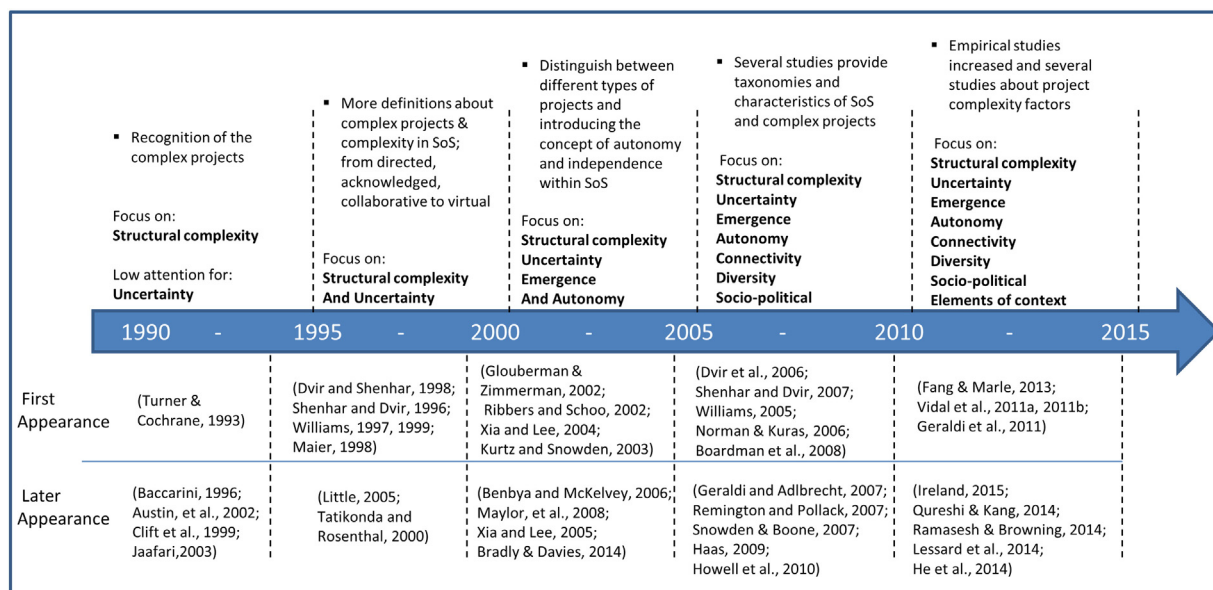


Fig. 1. Milestones of project complexity history (source: authors).

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