

Understanding project interdependencies: The role of visual representation, culture and process[☆]

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Abstract

Project portfolio management is central to many organizations' strategic processes and requires consideration of multiple factors and the ability to envision alternative future consequences to support strategic project portfolio decision making. Complex project portfolios with multiple project interdependencies are characteristic of many project environments, yet existing methods do not provide the clear understanding of project interdependencies that is required.

This exploratory study aims to improve organizational understanding of project interdependencies through two loosely coupled avenues of investigation conducted in tandem in a telecommunications and a defense organization. The first avenue of research introduces a new type of visual representation and shows that the creation of graphical network displays of projects and their interdependencies can provide benefits by supporting communication and strategic portfolio decision making. The second avenue of research tests a conceptual model and highlights the importance of both the culture and processes in an organization's understanding of project interdependencies.

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1. Introduction

Decisions about project investments are central to the realization of strategy in many organizations, especially the increasing number of organizations that are project based (Maylor et al., 2006; Thiry and Deguire, 2007). Project portfolio management (PPM) aims to enhance the return from project investments and contribute to an organization's competitive advantage by providing a holistic framework for the strategic management of the project portfolio. PPM requires consideration of multiple factors and

the ability to envision alternative future consequences to support and enhance strategic project portfolio decision making.

Many PPM tools and methods, while providing a portfolio-level perspective for balancing project decisions, still treat each project as an isolated entity. As PPM matures and project complexity and interdependency increase, it is no longer sufficient to apply traditional PPM tools that consider projects as independent of each other. In portfolios where many projects are interdependent, these interdependencies must be understood for effective decision making (Blau et al., 2004; Verma and Sinha, 2002).

PPM is more than an extension or scaled-up version of project management; the inter-project effects are more complex and difficult to predict (Aritua et al., 2009). Managing a portfolio of projects with uncertainty, dynamism, and complexity represent a complex multi-dimensional challenge. This challenge is amplified by the presence of interdependencies (Collyer and Warren, 2009; Perminova et al., 2008) and the management of interdependences is an area of weakness for PPM (Elonen and Arto, 2003).

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The research presented in this paper aims to help improve organizations' ability to understand the interdependencies within a project portfolio, and therefore improve their ability to make strategic portfolio decisions. The research asks whether network mapping visualizations can help organizations understand project interdependencies, and it explores other factors within a project environment that may influence that understanding. The research was conducted in two loosely coupled studies: the application of a network mapping approach for the visual representation of project interdependencies and the testing of a conceptual model of the factors that influence organizations' understanding of project interdependencies.

Section 2 starts with a review of the literature on the use of visual representations to support managerial and strategic decision making (Section 2.1). In Section 2.2 we present a brief overview of the literature on PPM and strategy, including a discussion on the visual tools commonly used to support project portfolio decision making. Section 2.3 explores the nature of project interdependencies and proposes a conceptual model on the factors that affect an organization's ability to understand project interdependencies. Finally, to conclude the literature review, Section 2.4 provides a brief review of literature on the application of network mapping and analysis for strategic and managerial decision making.

Building on the findings of the literature review, Section 3 introduces a network mapping approach to visualize project interdependencies that is proposed to support strategic project portfolio decision making. The methods employed for the two avenues of investigation in this exploratory study are then outlined in Section 4, followed by the findings and discussions from the two approaches in Section 5. Finally, we present conclusions, acknowledge the limitations of the research and suggest avenues for future research in Section 6.

2. Literature review

2.1. Visual representations and strategic decision making

Visual representations can provide an effective format for displaying and communicating information to support strategic decision making. Graphical forms of communication have the ability to illustrate complex multi-dimensional aspects of organizations in a simple and powerful manner (Meyer, 1991). Human cognitive capabilities process visual information differently from alphabetic, numeric, or verbal information. Visual information enhances analysis because it has the ability to be cognitively processed while preserving spatial orientations and interrelationships between multiple components, whereas alphabetic, numeric, and verbal information does not have that ability. As summarized by Ware (2005, p.29), the "power of a visualization comes from the fact that it is possible to have a far more complex concept structure represented externally in a visual display than can be held in visual and verbal working memories". In this way, visualization compensates for limitations in working memories and extends both the capacity and the duration of stored information (Tergan and Keller, 2005). For example, in a recent study, visual

displays are shown to aid in the attention, agreement, and retention of strategic information (Kernbach and Eppler, 2010).

Visual representations support a two-way relationship with strategy by helping to communicate and to shape strategic thinking (Warglien and Jacobides, 2010). Careful selection of the data and interrelationships presented in spatial and visual displays can guide decision makers. When used for strategic processes, visual representations must be able to assess multiple factors, capture historical events, and illustrate complex relationships (Platts and Tan, 2004). Common displays, such as 2×2 Matrix displays, are able to present multiple types of information in "2½-Dimensional" formats that are very powerful if well designed (Warglien, 2010). Most strategy displays are static by nature and, although there are attempts in some displays to incorporate representations of change and dynamism, the potential for *static bias* in visual displays should be acknowledged and studied (Warglien and Jacobides, 2010).

The advent of computers and software-based tools has greatly enhanced the ease of creating visual representations, making new types of visualization practical by providing new ways of collecting and displaying data (Dansereau and Simpson, 2009). Computer-based tools with visual interfaces combined with flexible human cognitive capabilities, such as pattern finding, combine the benefits of both and may be the most powerful and flexible cognitive systems (Tergan and Keller, 2005). For example, in a study on decision making in resource-constrained projects, computerized algorithms are combined with visual representations to provide the results in a condensed, manager-friendly format that increases acceptance and usability (Rivera and Duran, 2004). Similarly, the *tool for action plan selection* is a software-based tool that visually displays the cause-and-effect relationships between projects using a *connectance* concept between options in order to assist managers in evaluating the consequences of strategic decisions (Platts and Tan, 2004).

We have summarized here a few studies that explore the use of visual representations of strategic decision problems; however, there is a need for more research to better understand how they are used in practice and what types of visual representations improve strategic decision making (Warglien and Jacobides, 2010). Bresciani and Eppler's (2010) study of 12 common types of visual knowledge displays indicated the relative strengths of these methods. Some types of displays were found to be more flexible and adaptable, while others were suited to specific purposes. The authors found that 2×2 Matrix displays, like those used in portfolio maps, supported decision making and had particular strengths in evaluating and sharing information. In order to communicate effectively, the type of visual representation must be carefully selected and tailored to deliver the intended message in a way that is appropriate for the audience (Platts and Tan, 2004). These are important considerations for developing a method for communicating information about project interdependencies to support strategic project portfolio decision making.

2.2. Project portfolio management and strategy

PPM is a central part of the strategic management process as it involves decisions about which activities an organization

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