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Temporal boundary objects in megaprojects: Mapping the system with the Integrated Master Schedule

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Abstract

Recently, a stream of project management research has recognized the critical role of boundary objects in the organization of projects. In this paper, we investigate how one advanced scheduling tool, the Integrated Master Schedule (IMS), is used as a temporal boundary object at various stages of complex projects. The IMS is critical to megaprojects which typically span long periods of time and face a high degree of complexity and uncertainty. In this paper, we conceptualize projects of this type as complex adaptive systems (CAS). We report the findings of four case projects on how the IMS mapped interactions, interdependencies, constraints, and fractal patterns of these emerging projects, and how the process of IMS visualization enabled communication and negotiation of project realities. This paper highlights that this advanced timeline tool acts as a boundary object and elicits shared understanding of complex projects from their stakeholders.

Keywords: Timeline; Boundary object; Complex adaptive system; Sensemaking

1. Introduction

The importance of timelines, along with cost and quality, has been emphasized to facilitate successful project management (Adam, 1995; Moore, 1963; Williams, 1999; Yakura, 2002). However, little focus has been given to the role of timeline and scheduling tools in complex megaprojects, which typically involve multibillion dollar infrastructure projects or high end technology, and which are usually initiated by the public sector. These projects also usually involve a large number of public and private partner organizations over a long time (Turner, 1999; van Marrewijk et al., 2008). Additionally, megaprojects often result in time delays, cost overruns and failure to meet user requirements (Kwak and Smith, 2009). This is due to the large number of organizations involved and the number of parts, modules, and subunits that need to be integrated over a long period of time, before the end product of the project is visible. In megaprojects, it is difficult for members to develop a holistic/systematic project timeline understanding of the entire project. This is exacerbated by conditions of uncertainty and ambiguity in megaprojects that are perceived differently by multiple stakeholders across various geographical locations.

In this paper, we examine the role of advanced scheduling tools in megaprojects. Through a multiple case studies approach, we identify the critical role of Integrated Master Schedule (IMS) in shaping project boundaries and facilitating collective sensemaking across boundaries. In the following discussion, we present a theoretical argument and multiple case studies to demonstrate how the new generation of scheduling tools "can" and "should" be used as a powerful boundary object which enables the visualization and the mapping of a complex adaptive system (CAS). These discussions address our research question of: what is the role of advanced scheduling tools in megaprojects?

2. Boundary objects

The concept of boundary objects has been discussed in various organizational and management studies as a device to facilitate communication and gain a common understanding across multiple stakeholders (Levina and Vaast, 2005; Ruuska

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and Teigland, 2009). According to Star and Griesemer (1989), the classic definition of boundary objects is:

> …plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites… They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable means of translation. The creation and management of boundary objects is a key in developing and maintaining coherence across intersecting social worlds (Star and Griesemer, 1989: 393).

Star and Griesemer (1989) explain that objects require a common identity across diverse locations in order to be useful and meaningful to people. In this context, project management scholars support the critical role of boundary objects that enable and facilitate communication and action between different social actors (Alderman et al., 2005). For example, objects such as project contracts, plans, drawings, schedules, and instructions generate sensemaking effects in project negotiations (Koskinen and Mäkinen, 2009). These objects also support problem solving (Ruuska and Teigland, 2009), project integrations (Martinsuo and Ahola, 2010), and knowledge entrainment (Söderlund, 2010). Enberg et al. (2010) also illustrated how drawings and sketches as boundary objects were used to simplify complexity and make an effective solution for project members.

2.1. Timeline as a temporal boundary object

Yakura (2002) argues that timelines (e.g. Gantt charts, see Fig. 1) embody the key elements of narrative – a beginning, a middle and an ending, and a focal point – and act as special boundary objects. Timelines make the abstract notion of time concrete through the process of visualization, and enable communication and negotiation of time perspectives (Yakura, 2002). The visual representation of timelines thus helps members make sense of and create a common understanding of their projects (Henderson, 1999).

2.2. Timeline in megaprojects: Integrated Master Schedule (IMS)

Timeline plays a particularly significant role as a boundary object in megaprojects which face a high degree of complexity and uncertainty. Scheduling is critical to manage the "time limited" nature of projects (Moore, 1963). From the traditional view, scheduling tools were designed to provide external, objective, and explicit aspects of project activities (Adam, 1995). The most common first-generation tools are Gantt charts and PERT. These tools assume that projects are steady and linear (Aritua et al., 2009; Cooke-Davies et al., 2007) and have a limited capacity to encapsulate multiple and interdependent aspects of structurally complex projects (Williams, 1999). Consequently, advanced scheduling approaches, such as critical path method (CPM), critical chain method (CCM), PROMPTII, PRINCE2, and IMS have been developed and are commonly used in practice. Leveraging information technology, these products are capable of planning comprehensive allocation and synchronization of multiple aspects of projects over the long term.

The IMS is a new generation of scheduling tool designed to support the management of complex megaprojects. The IMS is defined as "a networked, multi-layered schedule containing all the detailed discrete work packages and planning packages (or lower level tasks or activities) necessary to support the events, accomplishments, and criteria of the Integrated Master Plan (IMP) of the project" (Department of Defense, 2005: 5). The IMS linked to an IMP is usually used in large developments for procurements and acquisition in government agencies, such as National Aeronautical and Space Administration (NASA) and Department of Defense projects, amongst others.

In terms of software architecture, IMS incorporates work breakdown structure (WBS), statement of work (SOW), and an earned value management system (EVMS), and establishes relationships between events, accomplishments, criteria, and

EXHIBIT 1
A Timeline for the OATS Project

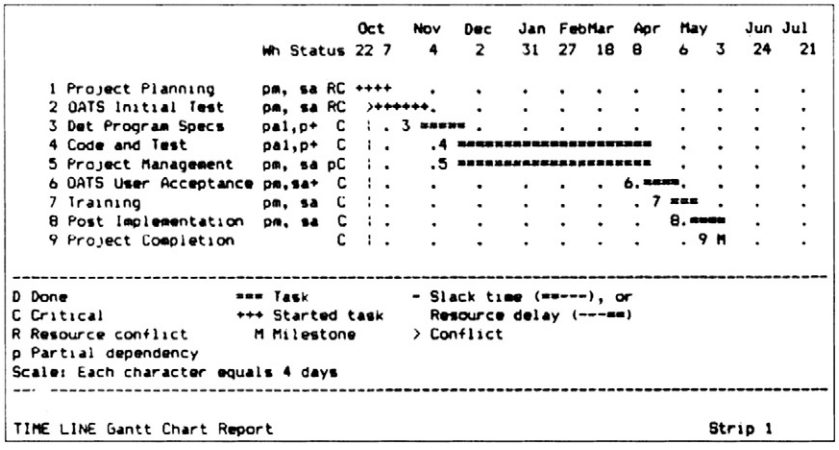

Fig. 1. Traditional two dimensional timeline (Yakura, 2002: 962).