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Team-based work and work system balance in the context of agile manufacturing

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Abstract

Manufacturing agility is the ability to prosper in an environment characterized by constant and unpredictable change. The purpose of this paper is to analyze team attributes necessary to facilitate agile manufacturing, and using Balance Theory as a framework, it evaluates the potential positive and negative impacts related to these team attributes that could alter the balance of work system elements and resulting "stress load" experienced by persons working on agile teams. Teams operating within the context of agile manufacturing are characterized as multifunctional, dynamic, cooperative, and virtual. A review of the literature relevant to each of these attributes is provided, as well as suggestions for future research.

Keywords: Teams; Agile manufacturing; Balance theory

1. Introduction

The purpose of this paper is to analyze the team attributes necessary to facilitate agile manufacturing, to review and integrate the literature relative to teams and agile manufacturing, and to provide direction for future research. It draws upon Balance Theory (Smith and Carayon-Sainfort, 1989) for evaluation of the potential positive and negative impacts related to agile team attributes, which could alter the balance of work system elements and resulting "stress load" experienced by persons working on agile teams. The term "agile teams" is used as a concise way to describe teams working in an agile manufacturing environment.

Manufacturing organizations are just beginning to adopt agility strategies; therefore, assessing the human impacts that could occur with agile teams at this time can help to ensure that research will support the needs of manufacturers and can assist companies in designing agile teams that contribute to job satisfaction and a high quality of work life. Before examining specific attributes of agile teams, a general review of agile manufacturing, teams, and Balance Theory is provided. Then, the paper describes four specific attributes of agile manufacturing teams and reviews literature related to each attribute, focusing on identification of positive and negative impacts to the work system. The paper concludes with suggestions and direction for future research aimed at improving our understanding of how pursuing a manufacturing agility strategy influences team-based work.

1.1. Agile manufacturing

Manufacturing agility is often defined as the ability to prosper in a competitive business environment characterized by constant and unpredictable change (DeVor et al., 1997; Goldman et al., 1995; Gunasekaran, 1999). Successful agile companies manage relationships in such a way that they "consciously make use of the state of change as a means to be profitable" (DeVor et al., 1997, p. 814).

Research on manufacturing agility has focused on the following four areas (Gunasekaran, 1999): (1) strategies such as virtual enterprises, supply chains, and concurrent engineering; (2) information technologies and hardware; (3) decision support systems such as production planning and control; and (4) issues related to people such as

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knowledge workers, employee empowerment, and training/education. Teams may play a significant role in each area. For virtual enterprises and supply chains, the emphasis is on strategic partnerships that enable companies to integrate core competencies on an as-needed basis. To facilitate the achievement of mutual objectives through these types of partnerships, a cross-functional and/or cross-organizational team is often created. In the case of concurrent engineering, a multifunctional product development team would typically include representatives of design, manufacturing, quality, purchasing, marketing, etc. The team might be restricted to employees within an organization or could cross boundaries to include suppliers or other strategic partners. In the areas of information technology, and production planning and control, improved software systems are being developed to enable teams to work together in a distributed or virtual environment. Finally, issues related to knowledge management, empowerment, and education have a significant interaction with teams, as companies strive to ensure that teams have the appropriate knowledge, skills, and authority to accomplish their objectives within a dynamic business environment.

Much of the current literature on agile manufacturing deals with enabling technologies and strategies, although human factors are acknowledged by Gunasekaran (1999) as an important element. Agile manufacturing theory emphasizes developing the knowledge and skills of employees to enable them to work in flexible, empowered work teams.

1.2. Teams

Teams are defined as a "distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited lifespan membership" (Salas et al., 1992, p. 4). The literature on agile manufacturing stresses both teams and strategic partnerships across organizational boundaries. A strategic partnership would not in itself constitute a team unless a group of individuals from each organization came together to share responsibility for certain outcomes. Thus, a strategic partnership could involve zero, one, or multiple cross-organizational teams depending on the scope of the partnership's objectives.

The most common types of teams used in manufacturing are for product development such as concurrent engineering teams (Taninecz, 1996) and operations improvement such as quality improvement teams (Cotton, 1993; Kano, 1993) or participatory ergonomics (Noro and Imada, 1991). A recent international survey of manufacturing practices found that 25.2% of the 898 surveyed firms used concurrent engineering teams "a lot" or "entirely", and 37.2% used team-based work practices for operators "a lot" or "entirely" (Clegg et al., 2002). The survey also reported that 41.8% of the firms were planning increased use of concurrent engineering, and 60.9% planned to increase use of team-based work, in general.

Teamwork can have significant positive and negative effects on organizational outcomes such as work performance, employee satisfaction, and health. However, due to the many variations of teamwork employed in industry, its impact on work organization and ergonomics is "largely undetermined and depends on a range of factors" (Sainfort et al., 2000, p. 988).

1.3. Balance theory

The Balance Theory of Job Design (Smith and Carayon-Sainfort, 1989) represents a work system through five elements: the individual, technology, task, organization, and environment. The latter four work elements interact with one another to result in a "stress load" on the person, which can, over time, lead to adverse effects to worker health and performance. "The essence of this theory is to reduce stress and the negative health consequences by 'balancing' the various elements of the work system" (p. 76). This can be accomplished by changing negative elements of the job or by enhancing positive elements. The key is to utilize a systems approach that considers all elements of the system, not just a small number of work factors. Each of the five elements is described in Table 1. The Balance Theory is used in this paper to frame and guide the analysis of team attributes that facilitate implementation of a manufacturing agility strategy and how these team attributes can impact work system elements in both positive and negative ways.

2. Team attributes for agile manufacturing

According to Goldman et al. (1995), an agile manufacturer must have the following four characteristics: (1) enrich the customer, (2) have a flexible organization that allows rapid reconfiguration of resources, (3) cooperate

Table 1
Elements of the Balance Theory of Job Design (excerpted from Smith and Carayon-Sainfort, 1989)

Element	Description
Environment	Physical environmental stressors such as noise, temperature, air quality, and housekeeping
Task	Characteristics of the work task including repetitiveness, meaningfulness, workload, pacing, control, etc
Technology	Any technological devices such as machines, computers, or software that influence the job. Technology can lead to the need for new skills, fear of job loss, changes in workload, or increased feedback about the work
Organization	Characteristics such as organizational support, training, career development opportunities, work schedule, role conflict, and ambiguity
Individual	Personal characteristics such as personality, physical health, skills and abilities, goals, etc