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## Lean and agile performance framework for manufacturing enterprises

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### Abstract

The overall performance of a manufacturing organization is a drastic function of the strategies applied to its physical sectors. Traditional strategies were based on the principle of economies of scale, which resulted in excess of waste and difficulty of reconfiguration. Global competition necessitates formulating efficient and effective paradigms in response to the global economies to improve the overall performance. Lean and agile manufacturing have been widely adopted in recent years' enterprises. Leanness mainly leads to eliminating the non-value added activities while agility focuses on leads to market responsiveness. This paper discusses the leanness and agility definitions, factors, paradigms, differences, and combination. A hierarchic framework is presented which can be used to measure the leanness, agility, leagility, and overall performance of an enterprise, further, to compare different enterprises. This enables using the multi-criteria decision making methods especially AHP and ANP. Levels of leanness and agility can be fed as input to define a variety of enterprises. Moreover, a different view is introduced for general features of an efficient/effective manufacturing organization irrespective to the definitions of leanness and agility.

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## 1. Main text

There is an increasing need to switch from the principle of economies of scale to global economies in the current competition environment. World-class performance becomes the goal of manufacturing organizations. Such performance is a moving target that requires never ending and alert processes of improvement in the applied manufacturing strategies. Manufacturing managers have sought performance improvements by adhering to currently popular paradigms, lean and agile manufacturing, or more broadly lean and agile enterprises. Notice that an enterprise is a collection of business processes that combined to produce desired results and a business process is a time ordered set of activities that accomplishes a purpose [1]. Lean means developing a value stream to eliminate all waste, including time, and to ensure a level schedule while agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market place [2]. Virtual corporation/enterprise means cooperation among many enterprises culminating in a virtual partnership or virtual confederation of supply chain partners [3]. A major issue in the formation of the virtual enterprise is the rapid integration and reconfiguration of the business processes of the participating enterprises. A virtual enterprise is conceived when a need is recognized in the marketplace and a set of business objectives is established. To conceive a virtual enterprise, it is important to consider an understanding of the customer expectations and how to satisfy their expectations [4]. A supply chain is a system whose constituent parts include material suppliers, production facilities, distribution services and customers linked together via a feed forward flow of materials and feedback flow of information [5, 6]. The supply chain can be analyzed into three main physical segments; sourcing, manufacturing, and delivery [7, 8].

This paper is organized into four consecutive sections. After the introduction, section two discusses the supporting literature of lean and agile manufacturing. Section three explores the factors that affect the overall performance of a manufacturing organization. These factors are described and arranged, according to the mutual relationships, in different levels of a hierarchy to enable evaluating and comparing general, lean, agile, or leagile enterprises. Additionally, the degree of leanness or agility can be measured at specific levels in the hierarchy. Therefore, leanness and agility can be separated trying to eliminate the communal confusions that appeared in the literature. Section four discusses the conclusion and future works.

## 2. Literature review

### 2.1. *Lean and agile concepts*

While there is plethora of studies on lean and agile, there are still confusions about their definitions and structures. They have been often recognized as concepts, theories, capabilities, paradigms, systems, philosophies, strategies, or practices. Narasimhan, Swink [9] stated that lean manufacturing and agile manufacturing are distinct, yet overlapping paradigms. Haq and Boddu [10] mentioned that for many, lean manufacturing and agile manufacturing sound similar, but they are different. Lean manufacturing is a response to competitive pressures with limited resources. Agile manufacturing, on the other hand, is a response to complexity brought about by constant change. Lean is a collection of operational techniques focused on productive use of resources. Agility is an overall strategy focused on thriving in an unpredictable environment [11]. The determinants or performance measures of product-end-user value (i.e. value metric) can be combined as quality, lead time, service level, and cost. Those determinants are classified into two categories: market qualifiers and market winners. In lean concept, quality, lead time, and service level are identified as market qualifiers, whereas cost is the market winner. For agile, quality, lead time, and cost are identified as market qualifiers, whereas service level is the market winner [1, 12]. Other strategies may change the sets of qualifiers and winners. For example, a current winner may become a qualifier after one year.

The lean and agile paradigms, though distinctly different, can be combined within successfully designed and operated total supply chains via a decoupling point [6]. That is called termed leagility. The decoupling point separates the part of the organization oriented towards customer orders from the part of the organization based on planning. Positioning the decoupling point in the supply chain determines the form of leagility. For successful leagility, Purvis,

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