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BRINGING TOGETHER LEAN, SIMULATION AND OPTIMIZATION IN A FRAMEWORK FOR SYSTEM DESIGN AND IMPROVEMENT

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ABSTRACT

Is it beneficial to combine lean, simulation and optimization? And if so, how can they be combined for decision-making support in system design and improvement? This research proposes a framework that sets the basis for achieving beneficial interactions between the lean philosophy, methods and tools, and simulation-based optimization. A framework that gives the users the possibility to get better system understanding, conduct a deeper system analysis, and attain an optimal system design and improvement, and thereby, get better foundation for sustainable long time improvement. The framework has been tested in several real-world case studies. Moreover, surveys have been conducted to evaluate the perception of subject matter experts about its usefulness, as well as its usability and perceived quality by end users and decision makers, all of them reporting very positive results.

1 BRINGING TOGETHER LEAN, SIMULATION AND OPTIMIZATION

The rapid changes in the market including globalization, the requirement for personalized products and services by the customers and the exponential growth of technological advances, will demand organizations to effectively design and improve their systems in order to survive. This is the actual paradigm characterizing the industrial sector, and in the future, probably even the service sector. In this scenario, to design and improve the production systems for shorter product life-cycles and including the new technological advances will be even more complex than before, leaving a challenge to decision makers who will need to take difficult decisions without compromising their quality. Decisions taken just based on their experience, knowledge and gut feeling will not be valid anymore. Lean being a widely applied management philosophy with very powerful principles, its methods and tools are static in nature and have some limitations when it comes to supporting decision makers when designing and improving complex and dynamic systems. Some authors have proposed the combined used of simulation with lean in order to overcome the limitations of its methods and tools. Furthermore, optimization and post-optimization tools coupled to simulation, provide with the knowledge about optimal (nearly optimal) system configurations to choose from, which can be of great support for decision-making. However, even if lean tools and simulation and optimization may have the same objective, to support organizations on system design and improvement, their combination has not been widely employed yet in the literature. Different studies focus only on how specific lean tools and simulation can be combined, treating lean purely as a toolbox and omitting the strength of lean which resides in its culture. Additionally, how lean can support the simulation process is not usually considered. The aim of this research is to present a framework for combining lean, simulation and optimization for system design and improvement where the limitations of lean tools and simulation are overcome by its combination. This includes a conceptual framework explaining the different existing relations between the lean philosophy, methods, and tools with simulation and optimization (Figure 1); the purposes for this combination including the educational, facilitation and evaluation purposes (Robinson et al. 2012,

Goienetxea Uriarte et al. 2015); a maturity model providing guidelines on how to implement it in any organization (Goienetxea Uriarte, et al. 2017a); existing barriers for the implementation (Goienetxea Uriarte et al. 2015); ethical considerations to take into account; and its possible users. An industrial handbook has also been written which explains how to employ and implement the framework step by step. This research has been conducted in three main stages including 1) the analysis of the literature and the real-world needs via interviews with different companies, 2) the development of the framework, and finally, 3) its evaluation in real-world projects (Goienetxea Uriarte et al. 2017b) and via surveys to get the perception on its usefulness by subject matter experts, as well as to evaluate its usability and quality by end users and decision makers who employed it in real-world cases. All these evaluations reported very positive results. The main contribution of this research is the framework and its components which will support decision makers take quality decisions in system design and improvement even in complex scenarios.

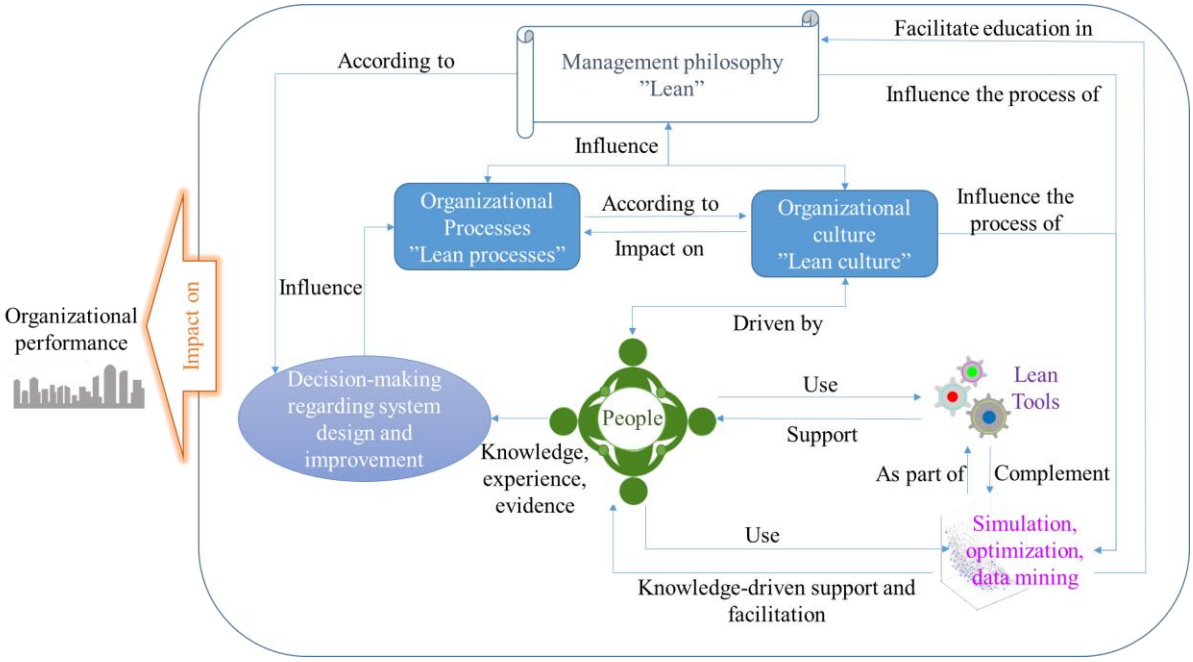

Figure 1: Conceptual framework of the combination (Goienetxea Uriarte et al. 2018).

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