



## Flexible-lean processes optimization: A case study in stone sector

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### ABSTRACT

During the downturn in demand in Engineering and Construction Architecture (AEC) activities registered in 2007, the Cluster of Mineral Resources of Portugal (CPMR) put into practice an initiative to boost the Ornamental Stone sector, based on incorporating lean thinking concepts, combined with techniques and technologies to make production processes more flexible. This was called the *leanstone hornbook (LH)*. Since then, the *LH* has been adopted by several Portuguese Ornamental Stone (OS) companies. For these companies, using the *LH* means changing their operations to a new model based on (i) their participation in R&D consortium projects, (ii) incorporating the resulting innovations, and (iii) combining innovation with lean thinking. Based on a convenience sample of OS companies, the objective of this research was to assess the economic-financial impact of *leanstone operations* on Portuguese OS companies. Through a methodological framework based on Key Performance Indicators (KPI) and Innovation Outcomes (IO), indexed to companies' economic-financial performance, *LH* was found to generate a potentially positive impact in terms of sales volume, exports, investment capacity and net result.

### 1. Introduction

During the subprime crises (2008–2010), the reduction in Architecture, Engineering and Construction (AEC) activities has naturally led to a sharp contraction in demand for construction materials in Europe and the USA [1], which has negatively affected exports of Portuguese Ornamental Stones [2].

To mobilise this important sector for the Portuguese economy and based on incorporating lean concepts combined with flexible production processes, the Cluster of Mineral Resources (CPMR) of Portugal then initiated an innovation dynamic called the "*leanstone hornbook*"<sup>1</sup> (*LH*). Adhering to *leanstone operations* would then mean participating in R&D partnership projects, incorporating lean techniques and modern production technologies that are environmentally friendly and energy-optimized, which could add value and increase quality and flexibility [3,4].

It is in this context that the following research question arises: What is the economic and financial impact of *leanstone operations* on Ornamental Stone companies in Portugal?

The research carried out revealed that specific, updated literature on the OS sector is not abundant. Additionally, from the published papers available, it was found that most do not reflect, or refer to, the dynamics of this sector in the last decade, considered traditionalist and therefore often neglected and poorly evaluated.

Therefore, the guiding research of this empirical study was based on comparing the economic and financial results of two groups of companies: one group that joined the *LH* before 2010 and a second group of companies that kept the traditional form of operations.

This research aims to assess the gains of the *leanstone operations* model, comparing the performance of the two groups of companies from 2010 to 2018 and in terms of: (i) sales volume, (ii) exports, (iii) investment capacity and (iv) net income.

In selecting the participating companies, an objective and convenient sample was chosen, which was not randomly performed.

### 2. Lean thinking production system

Since its advent, industrialization has been based on a process of

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<sup>1</sup> [https://sim4.isq.pt/wp-content/uploads/sites/92/2018/03/20180315\\_Evora\\_03\\_CEL.pdf](https://sim4.isq.pt/wp-content/uploads/sites/92/2018/03/20180315_Evora_03_CEL.pdf); accessed December 10th, 2019.