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# Lean Education as a Methodology for Supporting the Development of Training for Municipal Open Data Agents in Smart Cities

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## Abstract

In smart cities, the aim is to ensure the proper use of resources and integrate traditional infrastructure with digital technologies, all in service of their users. In this context, one of the key professionals is municipal open data agents, who contribute to the provision and processing of data necessary for building solutions within the urban ecosystem. This article, in a preliminary manner, seeks to contribute to an ongoing European project focused on the training of these agents. The objective is to assess the feasibility of applying Lean Education concepts and principles in the course development process, using a narrative literature review. It is concluded that the Lean method is an important pillar for the training to be developed in the capacity-building project, contributing to the development of qualified open data professionals capable of handling the complexity of data and transforming it into relevant information for urban management.

**Keywords:** Smart Cities; Lean Education; Open Data; Municipal Agents.

## 1. INTRODUCTION

With the growing government interest in promoting policies focused on smart cities, supported by specific technologies for these environments, opportunities arise for the development of professional competencies to meet new demands. Among the hey professional in this context are Municipal Open Data Agents, who play a crucial role in making available and processing data that contributes to development solutions for smart cities' stakeholders.

Smart cities integrate traditional infrastructure and digital technologies with the aim of serving their users and ensuring the proper use of resources (Batty et al., 2012; Camero & Alba, 2019). Technological interventions contribute to the gradual automation of daily activities in various domains of smart cities including: economy, environment, governance, quality of life, mobility, and people' well-being (Ahad et al., 2020; Camero & Alba, 2019).

Through the use of digital sensors, a significant amount of data is generated, making it necessary to apply data mining techniques that enable the visualization of correlations and patterns, which can support decision-making in relation to the mentioned domains. Thus, the open data movement has

gained momentum in government initiatives as part of a transparency agenda in relation to society (Batty et al., 2012).

In this sense, educational institutions are encouraged to provide training that is aligned with the demands presented, establishing dialogue and partnerships with other sectors of society. This participation brings educational institutions closer to local demands and contributes to the exchange of knowledge, enriching the construction of relevant training for the development of smart cities.

This line of thinking converges on a *Lean* proposal applied to the educational system, called "*Lean Education*", based on the principles and practices of Lean management, with a focus on delivering value based on the demands of beneficiaries (Emiliani, 2005). Thus, the research question is presented: how can *Lean education* contribute to the training of Municipal Open Data Agents in smart cities?

## 2. SMART CITIES: TRAINING OPEN DATA PROFESSIONALS

Countries such as United States and the United Kingdom have adopted open data policies and have made these data available on the portal[1] (Neves et al., 2020). In the European Union, there are a total of 1,632,029 datasets from 36 countries hosted on data.europa.eu (European Commission, 2023). In Portugal, specifically, the portal initiative (dados.gov.pt) began in 2011 and improved its position in the *Open Data Maturity Report 2022* regarding the level of maturity of open data (Portugal, 2023).

"Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and share alike" (Dietrich et al., 2012, p. 6). Their availability, in many cases, comes from supply initiatives without proper attention to creating value from the user's perspective. Some of the obstacles faced by users include: "1) availability and access, 2) find ability, 3) usability, 4) understand ability, 5) quality, 6) linking and combining data, 7) comparability and compatibility, 8) metadata, 9) interaction with the data provider, and 10) opening and uploading" (Zuiderwijk et al., 2012, p. 170).

Municipal governments must have the infrastructure and trained teams to establish monitoring and evaluation tools to promote the maturity of open data, seeking to improve the quality and scope of the dataset, with a focus on generating knowledge with significant impact on smart cities (Neves et al., 2020).

Regarding the research subject - professionals working with open data in smart cities - there is a need for them to develop competencies (knowledge, skills, and attitudes) to contribute to dealing with open data and support open data initiatives and decision-making. It is not enough for

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[1] The United States, through the data.gov portal, and the United Kingdom, through the data.gov.uk portal (Neves et al., 2020)

governments to make data available in a centralized portal; it is essential to involve citizens and organizations in the use of this data (Chan, 2013).

Educational institutions have the potential to make significant contributions to the learning journey of these open data professionals. However, given the routine in which individuals often balance study, work, and personal activities, it is important to plan an agile training process. The *Lean* principles and practices developed by the Toyota Motor Company focus on respect for employees and the quest for continuous improvement. This approach aims to eliminate waste and improve process flows (Balzer et al., 2016; Ghinato, 1995; Sanahuja, 2020). Recognized in the manufacturing industry, it has gained relevance in provision service, both in the public and private sectors, adapting to the peculiarities of each segment (Balzer et al., 2016; Kazancoglu & Ozkan-Ozen, 2019). In this way, the use of *lean* methodology in training for Municipal Agents is seen as a possibility for *lean* processes that aim to adapt the course to the participants' needs in a fluid and assertive manner.

This study presents a theoretical foundation that encompasses lean education, with the aim of contributing to the *Open Data City Officer* training project.

## 3. METHODOLOGICAL PROCEDURES

A narrative review approach was adopted to synthesize previous studies and identify perspectives for future research and projects (Ferrari, 2015). To avoid subjectivity in the selection of studies, a search strategy was developed, and selection criteria were aligned with the research objective, grounding the constructs related to lean education.

A search was conducted using the term *"lean education"* without restricting the time period in the following databases: *Scopus, Web of Science, ERIC* and *Scielo*. The result of this search was 34 scientific articles, excluding conference papers. After removing duplicates, 26 articles remained. Exclusion criteria were applied, such as papers unrelated to *lean thinking*, papers unrelated to educational institutions and papers in which *lean* was only the subject of a course or curricular unit. In the end, four papers were selected  (Balzer et al., 2016; Kazancoglu & Ozkan-Ozen, 2019; LeMahieu et al., 2017; Sanahuja, 2020). Their reading and analysis of cited references allowed the inclusion of other relevant papers (Emiliani, 2004, 2005; Ghinato, 1995; Kazancoglu & Ozkan-Ozen, 2019).

The synthesis was carried out through thematic analysis (Souza, 2019) with codes established based on the Lean stages defined by Balzer et al. (2016). To answer the research question, a comparison was made between the *Lean Education* stages and the ongoing European project, which focuses on filling the competency gaps of professionals in the field of open data, as a way to improve these professionals' capabilities in the context of digital transformation in cities.

## 4. *LEAN EDUCATION*

In the Lean perspective, both goods and services follow a *"pull"* system, pulled by demand, unlike the *"push"* system, which provides a certain volume of goods and services to the public, resulting in waste due to overproduction. In the educational sector, in addition to administrative activities, there are opportunities for applying Lean principles and practices in the development and updates of curriculum, learning assessment and the enhancement of the educational experience.

For this purpose, it is important to analyze student feedback, aiming to deliver value to the service beneficiaries within the requested timeframe and evaluating the impact of the adopted processes (Balzer et al., 2016; LeMahieu et al., 2017). Depending on the nature of the educational institution, whether it's public or private, service beneficiaries may include students, employers, investors and members of society in general (LEduc1) (LeMahieu et al., 2017). It is also important to consider the efficiency and effectiveness of resources in fulfilling the institutional mission (Balzer et al., 2016; Kazancoglu & Ozkan-Ozen, 2019). The following steps are presented for the implementation of *Lean* principles and practices:

> • identifying constituents who benefit from the process and what they value (LEduc1);
>
> • applying Lean tools and techniques to analyze the current process to surface wasted steps, efforts and inefficient flow among the process steps (LEduc2);
>
> • redesigning the process using Lean techniques that eliminate waste, improve flow and better meet constituents' needs (LEduc3);
>
> • implementing and regularly evaluating the updated processes using metrics that reflect what constituents expect from the process (LEduc4); and
>
> • continually improving the process with the ultimate goal of achieving perfection in the eyes of all constituents (LEduc5) (Balzer et al., 2016, p. 443)

Kazancoglu & Ozkan-Ozen (2019, p. 82) identified waste in higher education institutions, including "repeated tasks, unnecessary bureaucracy, errors because of misunderstanding/communication problems, excessive number of academic units and creation of an excessive amount of information" as some of the main wastes (LEduc2). Support tools for investigating waste include: value stream mapping, cause and effect analysis and establishing the flow of information between people and teams (Kazancoglu & Ozkan-Ozen, 2019; LeMahieu et al., 2017; Sanahuja, 2020).

Once the waste has been identified, a roadmap is needed to implement process transformations (Kazancoglu & Ozkan-Ozen, 2019). In a continuous improvement cycle, the PDCA model is used: *plan* (define the problem and plan possible solutions), *do* (implement solutions), *check* (evaluate the results) and *act* (act to standardize or, if necessary, replan) (LeMahieu et al., 2017).

Emiliani (2004) describes *Lean* principles and practices used in a postgraduate course aimed at aligning "what" and "how" the course is taught, improving materials with a focus on their relevance to students and eliminating waste by identifying which processes are related to delivering value to

beneficiaries. The result is an understanding of the expectations of those involved (LEduc3). To do this, it is necessary to understand who the end customer is, which can be the student themselves or, in the case of the mentioned course, employers who invest in employee training. Other results include less ambiguity in tasks, standardization of their formats and attention to students' time both inside and outside the classroom, as the schedules of many students make it impossible for them to dedicate themselves fully to the course (Emiliani, 2004).

Implementation requires long-term strategic planning, analysis of organizational culture, continuous organizational learning and, above all, commitment and involvement of leadership and educators throughout the process (LEduc4) (Balzer et al., 2016; LeMahieu et al., 2017). In this regard, Emiliani (2005) highlights *Kaizen*, known as *"continuous improvement,"* as an effective method for eliminating waste. The main advantage is the ability to achieve improvements quickly (LEduc5). Through observation, data collection, and critical analysis of activities, people identify low-cost, high-effectiveness solutions.

## 5. DISCUSSION

The ongoing European project aims to: build an occupational profile focused on open data for smart cities at the European level and develop a systematic curriculum designed for this profession, piloted through a Massive Open Online Course (MOOC). This format enables reaching a larger number of individuals in a flexible manner, concerning both time and space. However, the importance of face-to-face interaction is highlighted whenever possible, providing experiences that contribute to student-centered education. In order to contribute to the training in question, the literature presented in the article provides an opportunity to use *Lean Education* principles and practices.

### 5.1. Training Project for Municipal Agents in Open Data for Smart Cities considering Lean Education

To understand the applicability of *Lean Education* principles in the construction of the learning journey of the ongoing project, an analysis is conducted of the completed and ongoing stages considering the *Lean Education* methodology. Figure 1 systematizes the *Lean* stages, taking into account the project  (Balzer et al., 2016)*.*
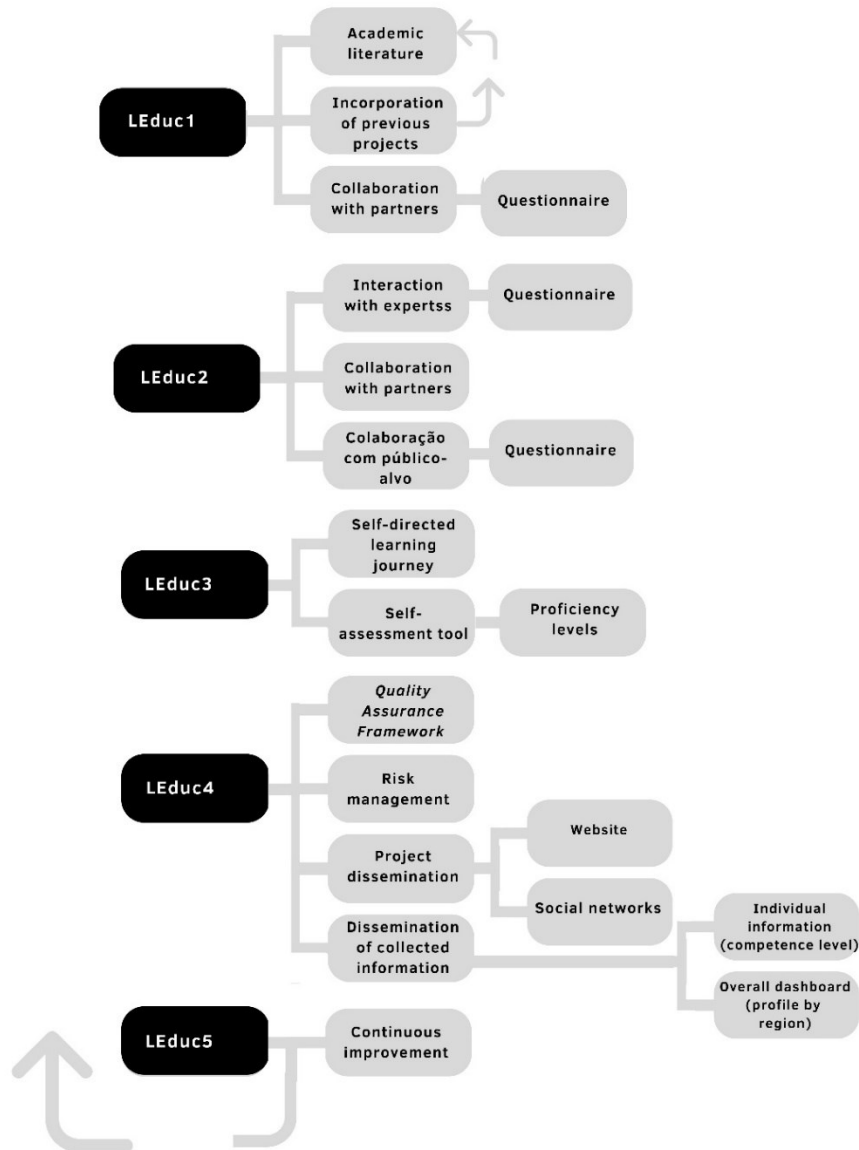
Figure 1 – Relationship of the Case with Lean Education Method.

Considering the first stage (LEduc1) - identifying the participants and what they value - the perception of the importance of this professional came from a previous project experience, the course with Municipal Agents focusing on resilience in smart cities. To define the professional profile for this new project, academic literature was utilized to list twenty competencies, emphasizing specific aspects of open data. These competencies were described taking into account the knowledge that underpins them, the associated skills and the expected attitudes of the professional regarding each competency. Contributions from project partners - project members, students, and experts in the field - through a questionnaire, validated the significance of training this professional with the respective competencies, listed below.
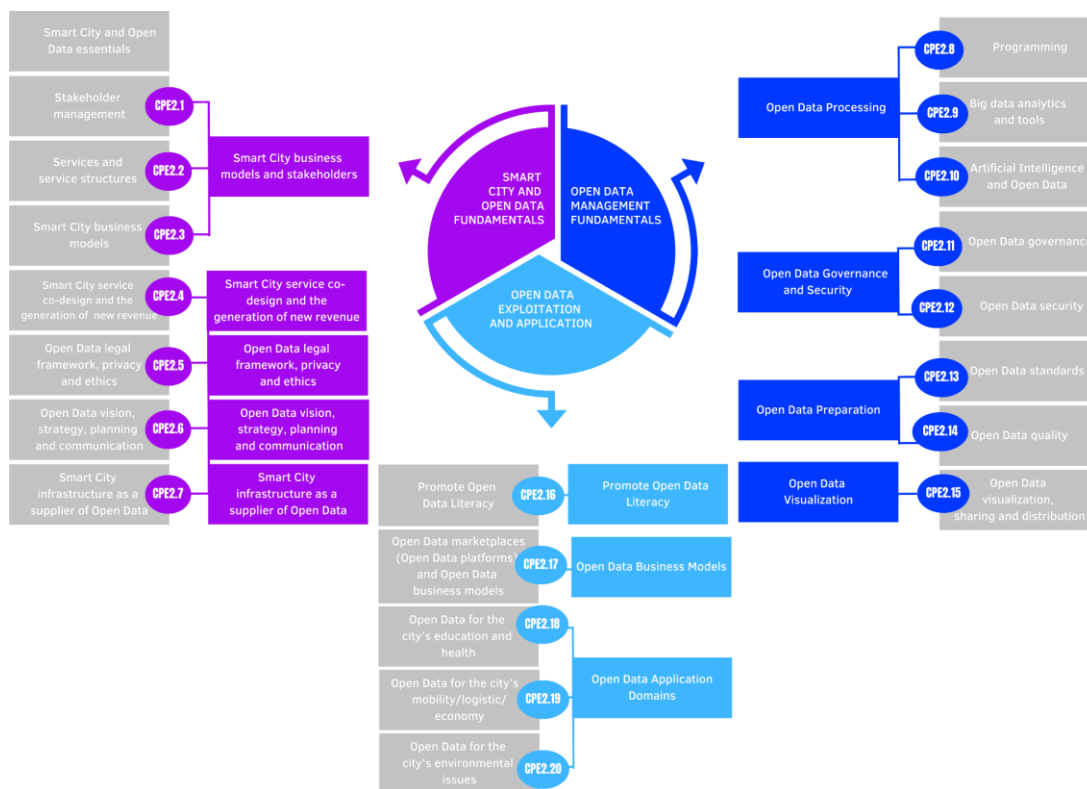
Figure 2 – Selected competencies for the training of municipal agents in open data.

In Stage 2 (LEduc2), which involves analyzing the current process to identify potential waste, assessments are conducted by experts for each competency and associated module, ensuring that the needs of the stakeholders are met. This ensures that each of the courses aligns with the requirements of the associated professional profile and, consequently, contributes to the development of smart cities in the domains of associated competencies. With these results, project members meet through web conferences and in person to analyze the outcomes and proceed with the subsequent stages of the project. Additionally, it has been decided to collect feedback from the target audience at the end of each module of the course so that improvements can be made throughout the course's execution.

In Stage 3 (LEduc3), which refers to the redesign of the process to better meet the needs of the stakeholders, the focus is on developing a learning journey that comprises the course, offering a self-directed approach. In the current development process, the team is designing a self-assessment tool for course participants. This tool will provide statements that introduce the four proficiency levels for each of the competencies associated with the course, reflecting specific knowledge, skills, and attitudes for each level. Assessing the proficiency level in these competencies will be crucial for selecting appropriate learning journeys to enhance student performance and value previous knowledge.

In Stage 4 (LEduc4), the plan is to implement and regularly evaluate the processes. In the project, the use of the *Quality Assurance Framework* has been defined, which assesses everything from management to the delivery of results, using both qualitative and quantitative indicators. Emphasis

is also placed on risk management, documenting risks and seeking to mitigate them. Additionally, the project's website will be made available to the public, presenting the results and progress of the project. Table 1 summarizes the theoretical framework and the European project in accordance with the stages of *Lean Education*.

| ETAPAS *LEAN* | LITERATURA | PROJETO EUROPEU |
|---|---|---|
| LEduc1 | Depending on the nature of the educational institution, these stakeholders may include students, employers, investors, and members of society in general (LeMahieu et al., 2017) | Students from a previous project, experts in the field of open data, and government agents. |
| LEduc2 | Multi-criteria decision-making method with waste recording (Kazancoglu & Ozkan-Ozen, 2019). Value stream mapping, cause and effect analysis, and flow of information establishment (Kazancoglu & Ozkan-Ozen, 2019; LeMahieu et al., 2017; Sanahuja, 2020). | The approach involves a literature review and previous experience: feedback from students and experts through questionnaires and meetings among project collaborators. |
| LEduc3 | Lean principles and practices used in a postgraduate course, resulting in an understanding of the expectations of the parties involved (Emiliani, 2004). | Development of a self-directed learning journey. A self-assessment tool is used to select a personalized learning journey based on proficiency levels for each competency. |
| LEduc4 | Implementation requires strategic planning, analysis of organizational culture, organizational learning, and commitment from leaders and educators (Balzer et al., 2016; LeMahieu et al., 2017). | *Quality Assurance Framework*; Risk management; Project website with results and project progress. |
| LEduc5 | Emiliani (2005) emphasizes Kaizen. | Continuous process improvement with the application of the previous stages, iterating as necessary. |

Table 1 – Relating the Case to the *Lean* Method

Finally, in Stage 5 (LEduc5), the aims are to constantly improve the process, ensuring that the professional's training remains aligned with the inherent dynamism of cities and the ongoing management of open data. In this regard, the application of *Lean Education* principles is intertwined with the project from defining the professional profile to structuring and executing the course, providing a solid and practical approach. This will lead to highly qualified professionals capable of navigating the complexity of smart cities with a focus on open data.

## 6. CONCLUSION

In a world constantly changing, there is a significant need to invest in the competencies of stakeholders in smart cities. They are the ones at the forefront, dealing with challenges, finding ways

to solve or mitigate losses, strengthening resilience and promoting sustainable urban development, with more inclusive and secure cities.

In relation to the project in question, it is evident that as cities face increasingly complex and dynamic challenges, the use of open data as a tool for cities becomes essential. Through access to and analysis of open data, cities can transform information into actionable knowledge, driving informed decision-making and improving the efficiency of urban policies.

This article, in a preliminary manner, contributes to the structuring of an ongoing project aimed at training Municipal Agents in open data for smart cities, guided by the principles of *Lean Education*. The process spans from defining the professional profile, identifying, and enhancing competencies to structuring and executing the pilot course. The methodology offers a solid and practical approach to the project in development.

Specifically, through the self-assessment tool, the goal is to identify competency gaps to be developed by the target audience, valuing previous knowledge, and making the learning process more fluid and more time efficient. The *Lean* method is an important pillar for the training to be developed in the open data training project for cities. This will result in highly qualified professionals capable of dealing with the complexity of data and transforming it into relevant information for urban management. This contributes to evidence-based decision-making, improved public service efficiency and greater transparency in municipal administration.

Collaboration among the involved partners is fundamental throughout the project's journey. In addition to the experience accumulated in previous projects, tools for monitoring and continuous improvement are planned. Finally, it is worth highlighting that this work presents contributions to the European project with *Lean* principles that will help steer both the current stage and shed light on future stages. Future work will seek to measure the impact of *Lean* education on the European project to provide insights for future research projects developing training models as a suggested methodology to be adopted.

Considering that the project is ongoing, other possible results related to *Lean Education* principles will be collected in the future, including a comparative analysis between the previous and current projects.

### ACKNOWLEDGMENT

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