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Meaningful inhibitors of the Lean journey: A Systematic Review and categorisation of over 20 years of literature

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Abstract:

Lean philosophy has been one of the most prominent methodologies of process improvement. Positive results from lean implementations have motivated managers to carry out lean transformations. However, the low success rates, linked to barriers to implement lean are still a challenge, and one of the reasons is the lack of understanding of these inhibitors. Scholars have investigated barriers that affect the lean journey, some of these barriers overlap and require a meaningful categorisation. Thus, the purpose of this paper is to fill in this gap by providing a review of more than 20 years of literature, and synthesising these barriers into meaningful organisational categories. To achieve this aim, we employed a systematic literature review. Our findings present six meaningful lean barriers, which we categorised into a framework. These barriers have mainly behavioural and organisational aspects (people-dependent), and technical aspects (tool-based). Finally, we derived eight propositions, contributing to knowledge and practice.

Keywords: Lean barriers; inhibitors, enablers; tool-based; people-dependent

Word count: 9381

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1. Introduction

Over decades, lean philosophy has been used as a significant organisational long-term strategy for process improvements, across different industries (Karlsson and Åhlström, 1996; Bhasin and Burcher, 2006; Radnor and Walley, 2010). Initially developed by the Japanese manufacturer Toyota, as its production system in the mid-1950's, it was later termed and spread across western companies as 'lean thinking' by Womack *et al.*, (1990). The lean approach focuses on waste elimination and creation of value for the customer (Hodge *et al.*, 2011; Radnor and Osborne, 2013), and that pragmatic methodology has supported manufacturers to achieve superior results, improving the processes and adding more value for customers (Womack and Jones, 1996; Bowen and Youngdahl, 1998). From the advent of the lean concept to the present day, lean has evolved, and its techniques and principles have been adapted in services areas (Allway and Corbett, 2002; Leite and Vieira, 2015; Yadav *et al.*, 2018).

The implementation of lean in the service industry has rapidly become a standard tested and used approach, with positive results in different areas, such as public services, construction, healthcare, offices and banks (Bowen and Youngdahl, 1998; Mazzocato *et al.*, 2012; Bateman, Hines and Davidson, 2014; Tezel *et al.*, 2018). The implementation of Lean principles in service industry operations has experienced similar benefits to manufacturing implementations, including waste elimination being tackled across the processes, adding value for customers (Bowen and Youngdahl, 1998; Kim *et al.*, 2006; Radnor, 2010; Radnor and Osborne, 2013).

Regardless of the positive results from lean implementation, the challenges to implement and sustain this new approach have emerged in both the manufacturing and services sector (De Souza and Pidd, 2011; Bhasin, 2012c). In literature, several scholars have reported on the low success rates of lean implementation (Bhasin, 2013; Sisson and Elshennawy, 2015b; Dorval *et*

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al., 2019). For instance, Jadhav *et al.*, (2014) found that two-thirds of implementations culminate in failure, and less than one-fifth of the ones implemented have sustained results. Some scholars have found lower success rates; for example, Bhasin and Burcher (2006) reported that less than ten per cent of companies succeed in implementing or sustaining the lean philosophy. Services and manufacturing organisations have encountered difficulties in sustaining the lean journey. Bhasin (2012a) and DeSanctis *et al.*(2018) advocate that the lack of ability to cope with barriers, faced in the implementation and sustainability process, is one of the main reasons for this low success rate.

Literature identifies lean barriers across different areas, such as manufacturing (Bhasin, 2012a; Yadav and Desai, 2017) healthcare systems (De Souza and Pidd, 2011), IT services (Kundu and Manohar, 2012), public services (Radnor *et al.*, 2006), and SMEs (Hu *et al.*, 2015). In literature, there are extensive examples of inhibitors that constrain the lean implementation, for instance the lack of resources (financial, time and human resources) (DeSanctis *et al.*, 2018; Bateman and Rich, 2003; Vienažindienė and Čiarnienė, 2013); lack of knowledge and understanding of the lean approach (Karlsson and Åhlström, 1996; De Oliveira *et al.*, 2018; Caldera *et al.*, 2019); leadership issues (Hacker and Doolen, 2005; Kim *et al.*, 2006; Yadav *et al.*, 2019); lack of organisational strategy (Albliwi *et al.*, 2014; Poksinska, 2010; Sreedharan *et al.*, 2018); resistance to change (Jadhav *et al.*, 2014; Salem *et al.*, 2016; Madsen *et al.*, 2017); and cultural hurdles (Bhasin, 2011, 2012; Timmons *et al.*, 2014; Muraliraj *et al.*, 2018).

These barriers are drawn from different settings and countries. For example, Dora *et al.*, (2016) investigated the impact of contextual barriers on lean manufacturing in SMEs operating in food-processing industries in Belgium. Another example, is the impact of leadership during the lean journey in Brazil, which was reported by Tortorella *et al.* (2018); in the UK, a study

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conducted by Bhasin (2013) reported several barriers that constrain lean in British manufacturing companies. There are other examples in developed countries, such as USA, Canada, Australia and Germany (Kumar, 2014; Fournier and Jobin, 2018; Kregel and Coners, 2018; Caldera *et al.*, 2019); similarly, barriers were found in developing countries, for example in China, Uganda, India and Kuwait (Alinaitwe, 2009; Al-Najem *et al.*, 2013; Jasti and Kodali, 2016; Gao and Gurd, 2019).

All the studies mentioned have contributed significantly, bringing new knowledge to academics and practitioners. However, after decades, the outcome of these research studies is merely a reporting of large lists of lean barriers (Poksinska, 2010; De Souza and Pidd, 2011; Hilton and Sohal, 2012; Aij *et al.*, 2013a; Mostafa *et al.*, 2013; Escuder *et al.*, 2018). These lists present some degree of saturation with similar barriers, many of which have considerable overlaps, and barely represent new barriers. This paper aims to present a framework which categorises and consolidates these barriers to provide a focused meaning for each barrier, and their impact within the lean journey in organisations.

Literature indicates that the categorisation of barriers is still a challenge, and only a few studies have provided insights into a classification of barriers, with most of these studies providing research only in specific areas, for example leadership, green lean six sigma, technical elements, or just in time (Nordin *et al.*, 2012; Jadhav *et al.*, 2015; Kumar *et al.*, 2016; Cherrafi *et al.*, 2017; Tortorella and Fogliatto, 2017; Zhang *et al.*, 2017; Yadav, *et al.*, 2018). Consequently, our study differs from previous studies for the following reasons, we do not aim to address exclusively lean history and create a timeline of its evolution, because we understand that there are relevant studies already published that cover this subject broadly (Rachna and Peter, 2003; Bhamu and Sangwan, 2014; Pettersen, 2009); we aim to narrow the focus and review 20 years of

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literature specifically related to lean inhibitors; our study is not limited to present a list of barriers in specific areas such as healthcare, services and manufacturing, but give a broader investigation across industry sectors; finally we aim to categorise these barriers into meaningful themes based on thematic analysis (Tranfield *et al.*, 2003).

To summarise, our study aims to systematically review, classify and synthesize the barriers that constrain the lean journey into specific organisational categories. Moreover, this categorisation of barriers aims to provide a framework that illustrates their interplay and impact on organisations, contributing to knowledge and practice. From these aims, we derived four research questions (RQs) that will guide our systematic literature review:

- RQ1: What is the current outline of lean barriers in literature?
- RQ2: What are the meaningful barriers that constrain lean implementation and sustainability?
- RQ3: How can lean barriers be categorised into an organisational framework?
- RQ4: What is the impact and interplay between lean barriers?

In order to achieve the aims of this research and answer the RQs, the paper is organised as follows: this first section introduces the context, benefits and barriers of lean philosophy, narrowing the focus to expound the research problem, justification and purpose. The next section discusses the methodological procedures based on a comprehensive systematic literature review. The section thereafter presents the research findings. The discussion section sets out propositions based on findings and literature. Finally, the conclusion summarises the research study, presenting the answers to the RQs, contributions and an overview of our study.

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2. Methodology

This section presents the methodological procedures used to collect and analyse secondary data from academic papers. Two different methodologies were used; the primary methodology used was a systematic literature review (Tranfield *et al.*, 2003) and, secondly, a thematic analysis was applied to find common themes and explain the data (Braun and Clarke, 2006).

A systematic literature review is a common approach to access secondary qualitative data in the literature. Several academics set out guidelines on how to carry out an effective systematic literature review (Tranfield *et al.*, 2003; Cronin *et al.,* 2008; Westby *et al.,* 2008). Such reviews are encouraged by scholars that have carried out research on lean (Brandao de Souza, 2009; Mazzocato *et al.*, 2010; Hu *et al.*, 2015; Yadav and Desai, 2017). The use of a structured protocol provides trustworthiness and reliability to the study. It is a meticulous procedure with details of the searching protocol providing the opportunity for future replications of the search (Tranfield *et al.*, 2003; Bell *et al.*, 2018). The main elements of a protocol are the definition of inclusion and exclusion criteria, the selection of peer-reviewed journals from specific databases, the definition of key words and search period, as well as the saturation of the search.

In order to access rich secondary data from literature, we explored the inclusive criteria, only conducting our search in trade and academic peer-reviewed journals in several databases including, Science Direct, Emerald Fulltext, Springer Link, Taylor and Francis Online, Ebsco, Medline, PubMed and Inderscience. There were three exceptions to the peer-reviewed journals, the Lean Enterprise Institute – New Survey, Manufacturers & Exporters - Management Issues Survey and Deloitte & Touche - Lean Manufacturing Survey Report. They were selected due to their technical and practitioner nature related to Lean. The use of non-academic articles focused on lean practitioners is supported by other scholars (Conn *et al.,* 2003; Hopewell *et al.,* 2007).

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When carrying out a systematic literature review on lean product development, Salgado and Dekkers (2018) advocate that the consideration of non-academic literature or 'grey literature', provides invaluable information to the field.

The period of the publications considered was based on the availability of papers up to the end of the 1st quarter of 2019 with the first paper found dated from 1996 (Karlsson and Åhlström, 1996). The search considered over 20 years of publications related to lean barriers. Finally, the inclusive search criteria encompassed the key words: 'lean barriers', 'lean challenges', 'lean constraints', 'lean inhibitors' and 'lean failure', and considered the fields of title, abstract and key words. The predetermination of key words chosen to search databases, during the systematic literature review, supports the purpose of our study, and is also encouraged by scholars that have undertaken similar studies (Brandao de Souza, 2009; Robson, 2011).

The main exclusion criteria considered only papers written in English and papers that address lean in operations or in production management, as some papers use the term 'lean' in medical research. It is possible that one might find all these details and information overwhelming, as they take into consideration every part of the procedure of the research protocol. Therefore, in order to help an audience better understand our protocol, we created a literature review framework that makes our approach more visual and describes the steps taken. This is common practice among scholars that carry out this type of research (Hu *et al.*, 2015; Salgado and Dekkers, 2018; Sweeney *et al.*, 2019) and is based on the criteria displayed in Figure 1, which aims to identify and select suitable papers.

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…Insert Figure 1 About Here…

The screening process was then carried out in two phases. The first screening phase considered papers that presented the key words from the inclusion criteria in at least one of the fields of title, abstract or keywords. This screening led to the acquisition of 346 papers that presented some relation to the selection criteria. In the second screening phase, the researchers carried out an in-depth and meticulous analysis of the abstract and body of these papers, checking their eligibility based on the exclusion criteria, in order to find if they could contribute in any way to the purpose of this study. The results of this further analysis excluded 142 articles leaving 204 papers for in-depth analysis in our study. Moreover, a database was created using an Excel spreadsheet to extract information that included the authors' name, year of publication, purpose of the paper, methodology applied, main barriers found, and the main contribution of the paper. A similar approach, when carrying out systematic literature review, is suggested by Tranfield *et al.* (2003) and Sweeney *et al.* (2019).

The analysis and reporting of this data followed the suggestions made by Tranfield *et al.* (2003) that separate this process into descriptive analysis and thematic analysis (Braun and Clarke, 2006; Hu *et al.*, 2015). The descriptive analysis presents an overview of the findings in literature. A set of categories representing the distribution and allocation of literature during the years of publication. For instance, it can describe geographical elements, type of research approach, and common areas of application (Tranfield *et al.*, 2003).

The thematic analysis is one of the most common methods in the qualitative field and allows the researcher to code and keep track of the data. Moreover, it provides a level of sensitivity to the details and context, ensuring accurate access to information (Braun and Clarke,

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2006; Radnor and O'Mahoney, 2013). In the thematic analysis, the data is first inducted into meaningful codes. In our research, the codes will be represented by inhibitors found in the literature researched. Thereafter, these codes will be merged into meaningful themes that appear as the main barriers and are based on repetition. These themes are supported by extracts from texts (Radnor, 2002; Braun and Clarke, 2006). For instance, several inhibitors might emerge, such as lack of financial resources, budget constraints, lack of investment and human resource constraints. These inhibitors will be labelled as codes, and later clustered around the main theme, which is the main barrier related to resource constraints.

The linking of codes into themes across different contributions, in literature and to report on the findings, is an important part of the research process. It is essential to assert that the results are deemed trustworthy, and to later enable the recommendation of a reliable approach (Patton, 1990; Tranfield *et al.*, 2003; Saunders *et al.,* 2012). Through the use of data from extraction forms, we provided the main findings from our research based on the descriptive and thematic analysis. The following section of this paper addresses the findings of our research based on the descriptive and thematic analysis performed.

3. Findings from the Descriptive and Thematic Analysis

In this section, we present the data gathered on the extraction form, presenting firstly an overview of the findings from literature using descriptive analysis. Subsequently, we aim to present the data analysis based on thematic analysis.

3.1 Descriptive Analysis

The descriptive analysis synthesizes the findings of our research; it provides an outline of the current state of publications related to lean barriers. The analysis considered relevant information

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from the papers researched, for example, geographic distribution of the publications, different methodological approaches undertaken, and type of industry sectors. This is a categorisation of the rich data found in literature, and it provides significant information for further discussion in line with our RQ1.

Figure 2 depicts the geographic distribution of the papers found in literature, and provides information about regions in which the studies have been conducted. During the phase of data collection, several countries were identified, some of them with high repetition and others with low repetition. Therefore, in order to make the visual representation of the chart easier to understand, we decided to organise them into their geographic regions.

…Insert Figure 2 About Here…

In the Scandinavian region, Denmark, Norway and Sweden were found. For Europe, the countries that emerged during the data collection were Netherlands, Belgium, Germany, Hungary, Italy, the Netherlands, Switzerland and the United Kingdom. In Africa, the only research found was in Uganda and, in the Middle East region, research was found in Kuwait, Lebanon, Qatar and Saudi Arabia. For Asia, research was found in China, India, Indonesia, Malaysia, Thailand and Sri Lanka. In Oceania, research was carried out in Australia and New Zealand. Finally, in the Americas region, research was reported in Brazil, Canada, Mexico, United States and Uruguay. Moreover, two categories were created for papers that do not fall into any of these regions. First, a category named ‘not informed’ (NI) for studies that do not provide their location; second, a category named ‘literature review’. These are literature review papers that are not focused on a specific region or country, but rather have a wide coverage.

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Thus, considering the papers in which the geographic location was informed, the results show that research on lean barriers are concentrated in three regions. Europe is providing research on lean barriers occupying 18% of the papers (e.g. Bateman and Rich, 2003; Radnor *et al.*, 2006; Bhasin, 2013a; Hadid *et al.*, 2016), followed by the Americas and Asia, with 14% each (e.g. Sim and Rogers, 2008; Pingyu and Yu, 2010; Balzer *et al.*, 2015; Costa *et al.*, 2017; Marodin and Saurin, 2015; Kumar and Kumar, 2015). Other regions such as Scandinavia, the Middle East, Oceania and Africa, have a smaller participation in terms of volume of research conducted, and together account for 9% of the publications (e.g. Alinaitwe, 2009; Maalouf and Gammelgaard, 2016; Aoun *et al.*, 2018; Hihnala *et al.*, 2018; Caldera *et al.*, 2019).

The research methods carried out when investigating the barriers that affect the lean journey were identified and presented in Figure 3. The methods found were action research, case study, focus group, literature review, mixed methods and survey. When listing these categories of research methods from the literature searched, we aimed to provide a standard and comparable list of research methodologies. However, some studies do not present identical nomenclatures for their research methods, even though they use the same methodology. Then, when gathering and analysing the data we aimed to keep related methods together. For instance, some of the authors describe their method as a descriptive survey questionnaire, an electronic survey, a questionnaire and a structured questionnaire. In this case we created a standardized category named 'survey'. A similar situation is presented in the 'case study' category that congregates research methods named as single or multi case study, in-depth case study and case method study. Furthermore, the 'literature review' category gathers papers that used the analysis of secondary data from literature to carry out their research, such as analysis of papers, systematic literature review, bibliometric analysis and literature survey.

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…Insert Figure 3 About Here…

The results show that the main research methods carried out, when investigating lean barriers, are case study and literature review, both of which account for 30% of the frequency. For instance, Stankalla *et al.*, (2018), when investigating critical factors for lean implementation in small and medium-sized manufacturing enterprises, conducted a literature review considering different countries. The case study method was used by Ainul Azyan, Pulakanam and Pons (2017) to explore barriers to implement lean in the printing industry. The second most common research method is survey accounting for 24%. As an example, this method was undertaken by Bhasin (2013a) when investigating low success rates of lean implementation in British manufacturing organisations. A smaller group of other methods, encompassing action research, focus group and mixed methods accounts for 5% of the methods carried out in the papers searched (Fernandez-Solis *et al.*, 2013; McDermott and Venditti, 2015; Lindskog *et al.*, 2016). We also found papers in which the type of research method carried out was not clear which was later named as 'not informed' (e.g. Barker, 1998; Boyer and Sovilla, 2003).

The interest in implementing lean in different sectors has increased (Danese *et al.*, 2018). The research presented in this paper focuses on specific areas, and supports scholars and practitioners in their understanding of the impact of lean inhibitors in different sectors. Figure 4 displays the results of the research analysis identifying nine main industry sectors: construction (Alinaitwe, 2009; Shang and Sui Pheng, 2014; Tezel *et al.*, 2018), healthcare (Fine *et al.*, 2009; De Souza and Pidd, 2011; LaGanga, 2011; Drotz and Poksinska, 2014), higher education (Albliwi *et al.*, 2014; Balzer *et al.*, 2016; Rexeisen *et al.*, 2018), IT (Kobus *et al.*, 2018; Shamsi and Alam, 2018; Yadav *et al.*, 2018), manufacturing (Bateman and Rich, 2003; Bhasin, 2012c;

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Worley and Doolen, 2015), mixed (Salem *et al.*, 2016; Soliman and Saurin, 2017; Muraliraj *et al.*, 2018), public service (Radnor and Walley, 2008; Radnor, 2010; Kregel and Coners, 2018), services (Staudacher and Tantardini, 2012; Leite and Vieira, 2015; Sreedharan V. *et al.*, 2018) and SMEs (Wilson and Roy, 2009; Rymaszewska, 2014; Sahoo and Yadav, 2018).

…Insert Figure 4 About Here…

When classifying the paper into areas and categories specific challenges were encountered. For example, the service sector is a broad category, which congregates papers found without specifying any particular area within the service sector, often informed only by the authors as lean barriers in the service sector. Another example, the public service category draws together different studies carried out within the public management field. Furthermore, some papers would present research carried out in several industry sectors, therefore, they fell into a category named as 'mixed'. Finally, there were papers that did not specify the industry sector, which were classified in the 'not informed' category.

Figure 4 shows the predominance of studies related to lean barriers in the manufacturing sector accounted for 37% of the papers. We believe that this is related to the nature and maturity of lean thinking, which began on the shop floor of factories (Womack *et al.*, 1990). Similar results were found by Danese *et al.*, (2018) who consider the manufacturing sector as a mature and consolidated research setting. The results also report the healthcare sector ranking as second, with 18% of the studies found in this area. Healthcare is a common theme researched in the lean concept, in which several scholars have carried out relevant studies, including some significant literature reviews (Brandao de Souza, 2009; Mazzocato *et al.*, 2010; Burgess and Radnor, 2013a). Furthermore, research on SMEs and Services, combined, accounts for 15% of the papers found,

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and shows the increasing relevance of these two areas. There are also other different industry sectors that show how these research studies are spread across different areas, such as construction, higher education, public services and IT, which together account for 12%.

Regardless of the predominance of studies carried out in the manufacturing sector (n=37%), the scoring of the relevance of the service sector in general is regarded as important. For example, when considering all industry sectors that are not related to manufacturing (including SMEs and NI studies), a broader category of services emerges with 35% of the research studies. This confirms the trend that manufacturing is a mature field of research (Danese *et al.*, 2018). However, it also informs that the service industries are a prominent field to conduct new lean studies.

This section of the paper addressed the descriptive analysis of the data, and presented an important summary of the presence of lean barriers across different geographic regions, the type of methodologies that have been carried out in lean studies, as well as different industry sectors that presented lean barriers to research studies. The next section tackles the thematic analysis and presents the barriers found in literature.

3.2 Thematic Analysis

The thematic analysis aims to find meaningful 'themes' that emerge from groups of codes. This is one of the most common approaches amongst scholars carrying out qualitative analysis (Radnor, 2002; Tranfield *et al.*, 2003; Bell *et al.*, 2018). This phase of the analysis is in line with RQ2.

In our process of thematic analysis the aim was to find common codes related to lean barriers, for example, when the barrier lack of resources or financial constraints emerged, they were individually labelled as codes. This process was sequentially repeated across the entire

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database of the papers selected, and a long list of codes related to different lean barriers was generated.

The next step of our thematic analysis aimed to induce and cluster the relevant codes in line with each meaningful theme. Thus, the codes were organised according to their repetition in literature and were connected to a common subject, and were later merged into broader themes. Table 1 displays a list of the ten most repeated codes and how they merged into a meaningful theme. Due to the volume of papers reviewed, naturally a range of related similar codes emerged which were considered in our analysis. However, for the purpose of illustration, and aiming to provide the '*modus operandi*' and rigor of the analysis we have limited the display, in alphabetical order, to the ten most common codes related to each of the six themes (Table 1).

…Insert Table 1 About Here…

The definition of themes is suggested by Braun and Clarke (2006) as a process of identifying the 'essence' of the theme, providing names and aspects captured by each theme. Therefore, as researchers, we independently examined and reviewed this process of theme definitions, and after discussing the meaning of each theme, we found some degree of consensus, hence we identified the themes presented in table 2.

…Insert Table 2 About Here…

The themes are presented in order of frequency in which they emerged during the thematic analysis. The 'behavioural and cultural influence' theme accounted for 22.14% of the frequency

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during the analysis. This theme related to people's behaviour and culture, and how they constrain lean implementation, for example, the employee's barriers to lean implementation, backsliding and falling into the old ways of working and professional barriers (Čiarnienė and Vienažindienė, 2013; Machado Guimarães *et al.*, 2013; Jasti and Kodali, 2016). The 'behavioural and cultural influence' theme is mainly focused on addressing resistances to change that affects lean. For example, Ramadas and Satish (2018), when analysing factors associated with employee barriers in SMEs in China, found that the cultural resistance to change is a strong inhibitor during the implementation of lean. Although, this theme addresses people's behaviour towards lean, it deals with the influence of leadership, which is a specific subject for later discussion.

'Organisational strategy and alignment' is a relevant theme that emerged and occupied the second highest frequency while conducting the data analysis, accounting for 21.84% of the frequency. This theme is related to organisational conduct and influence that affect the lean journey. Some barriers related to this theme are slow pace of change, organisational structure and lack of a clear long-term vision (Radnor *et al.*, 2006; Worley and Doolen, 2015; Belhadi *et al.*, 2018). Thus, it addresses issues resulting from inadequate organisational culture, such as poor strategy and vision when implementing lean. When conducting the literature review with the aim of identifying the main challenges faced during lean implementation, Mittal *et al.*, (2016) and Alkhoraif *et al.*, (2018) found inadequate organisational structure as a prevailing inhibitor.

'Technical limitation' accounts for 19.18% of the frequency of the theme, and addresses the tools, knowledge and learning issues associated to lean. Some examples of barriers come from technology-based constraints, lack of knowledge, as well as the lack of a methodology (Kumar, 2014; Jasti and Kodali, 2016; Yadav and Desai, 2017). Moreover, technical limitations emerged from the lack of knowledge and experience with lean philosophy. Piyathanavong *et al.*

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(2019) report on barriers related to this theme when assessing lean implementation in manufacturers in Thailand. Barriers related to knowledge were also found by Ramadas and Satish (2018) when carrying out research on SMEs in India.

The 'process-based' theme emerged with 13.57% of frequency in the thematic analysis. This theme addresses the parts of operations that affect lean implementation, as well as customers and suppliers. Some of the barriers that emerged during the coding process are poor supplier integration, transfer of manufacturing concepts to another industry sector, and fragmented implementation (Dora *et al.*, 2014; De Oliveira *et al.*, 2018; Gao and Gurd, 2019). When investigating the impact of the operations strategy in the National Healthcare System in the UK, Matthias and Brown (2016) reported significant operational hurdles that constrain the lean journey in the healthcare sector.

The theme 'leadership commitment' accounted for 12.86% of the frequency of the thematic analysis, and it deals with the impact of leadership in all levels during lean implementation and sustainability. During the coding process, several prominent barriers emerged, such as lack of participation of leadership in lean transformations, lack of awareness amongst managers and lack of interest by top management (Boyer and Sovilla, 2003; Cherrafi *et al.*, 2016; Yadav *et al.*, 2017). The impact of leadership commitment on lean was found in different levels of leadership. For example, Nordin *et al.*, (2018) while carrying out a survey with manufacturers, found a lack of top management support for lean change. There are also other prominent obstacles to lean, such as insufficient supervisory skills to implement lean, which was also reported by Bhasin (2012) and Canadian Manufactures and Exporters (2006).

Finally, the theme related to 'resource constraints' accounted for 10.41% of the frequency. This is a common topic in literature, and addresses the lack of any type of resource during lean

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implementation, such as lack of financial and human resources, and lack of time (Albliwi *et al.*, 2014; Marodin *et al.*, 2015; Khaba and Bhar, 2018). Literature provides several examples of how the constraint of resources can affect lean implementation and sustainability, for instance, Bateman and Rich (2003), when carrying out a survey amongst British manufacturers, found the lack of equipment and people as a barrier to the lean journey.

This section synthesised the findings of our study, addressing the thematic analysis. The results showed that there are several barriers related to lean. Frequently, these barriers present similarities and overlaps, without significant differences in meaning. Therefore, we categorised these barriers into codes that were later clustered into six main themes, this represents meaningful barriers that constrain the lean journey. The next section provides an in-depth discussion of these results.

4. Discussion and propositions

The findings of our study show that there are several inhibitors that constrain the lean journey. This variety of challenges also shows that there is no unique recipe for implementing lean and succeeding, or as argued by Dixon-Wood and Martin (2016, p. 193) there is no *'magic bullet'*. Indeed, every organisation is different in terms of sector, product and service, therefore, a replication of another organisation's lean process is a mistake, since lean depends on context and culture, organisational pressures, and supporting infrastructures vary between companies (Dixon-Woods *et al.,* 2011; Bhasin, 2012a; Radnor and Osborne, 2013; Leite and Vieira, 2015). Thus, we argue that the barriers that constrain lean implementation should be addressed individually, considering their impact within the organisation. Our study found six main barriers that emerged from the data analysis: 'behavioural and cultural influence', 'organisational strategy and

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alignment', 'leadership commitment', 'technical limitation', 'process-based', and 'resource constraints'. This categorisation does not aim to generalise barriers, but rather proposes a clear focus on organisational aspects.

Since lean is context-dependent (Radnor *et al.*, 2012), it is important to acknowledge that these barriers have different restraining forces in different settings and organisations. Thus, to understand and explain the interplay and impact of these barriers within the organisation, we designed an organisational framework to identify the barriers according to their nature and influence (Figure 5). The framework using the six themes (table 2) is divided into two levels, which makes an analogy of the elements that are visible, above the surface (technical aspects, and therefore, the tool-based approach), and elements that are less visible, underneath the surface (behavioural and organisational aspects, and therefore, those depending on people). This type of approach, with levels of visibility of the elements in a framework, draws on the work by Hines *et al.* (2011, p. 9) when explaining their 'Lean Sustainable Iceberg Model', which address only enablers for lean implementation. There are also other fragmented studies that highlight the categories of ostensible barriers (barriers that apparently are responsible for causing a problem, but not necessarily so (Leite *et al.*, 2019)) on people, and organisational and technical aspects (Jina *et al.*,1997; Brandao de Souza, 2009; De Souza and Pidd, 2011; Čiarnienė and Vienažindienė, 2013; Kinder and Burgoyne, 2013b; Vienažindienė and Čiarnienė, 2013; Tortorella *et al.*, 2018; Yadav *et al.*, 2018; Leite *et al.*,2019). Our framework focuses on barriers, and considers the prominent hurdles that might influence the lean journey in different technical, behavioural and organisational aspects. The categorisation of the barriers into an organisational framework is in line with our RQ3.

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…Insert Figure 5 About Here…

The bottom level of the framework addresses three barriers that are related to 'behavioural and organisational aspects', which are considered less visible and are people dependent. The first barrier in this level is the 'behavioural and cultural influence', which is related to people's behaviour and culture. Some examples of inhibitors that come from this barrier are resistance to change (Bateman and Rich, 2003), people backsliding and falling into old ways of working (Emiliani and Stec, 2005), and lack of interest and commitment (Radnor *et al.*, 2006). Some scholars address this type of barrier as a human or people-related barrier (Čiarnienė and Vienažindienė, 2013; Henao *et al.*, 2019), due to its impact on human behaviour during lean implementation (Sahoo and Yadav, 2018). The understanding of this barrier is relevant to enable future implementation; according to Chougule *et al.* (2011) the behavioural and cultural influence can guide people into providing information about the organisation's current shortcomings in sustaining change, associating this to a lean enabler, rather than an inhibitor. In this regard, Knight and Haslam (2010) consider that the commitment and motivation of those involved in the lean journey allow the empowerment of employees, who are the ones that promote the actual change on the shop floor (Angelis *et al.*, 2011; Savage *et al.*, 2016). This leads us to our first proposition related to behavioural and cultural influence:

Proposition 1: Peoples' behaviour and culture during lean implementation is a strong inhibitor and can lead to various types of resistance. However, when directed correctly, it can enable empowerment and sustainable change.

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The second barrier in this level is 'organisational strategy and alignment', and this inhibitor represents issues related to organisational conduct and influence in lean implementation and sustainability. Some examples of inhibitors are insufficient to understand the potential benefits (Bhasin, 2012b, 2013b), lack of long term-strategy (Sisson and Elshennawy, 2015b), and rigid organisational culture (Radnor and Boaden, 2008). The way in which the organisation leads the change is the key element to overcome these challenges, for instance, creating a lean environment in an organisation involves changing its strategy, becoming a lean-thinking, rather than problem-solving based organisation (Bhasin and Burcher, 2006; Jain and Ajmera, 2019). Thus, supportive organisational strategies and alignments are essential to implement successful lean initiatives, as they help to build confidence, ease cultural changes and become aligned with the new improvement system (Bhasin, 2013b Achanga et al., 2006; Rise and Haddud, 2016; Escuder *et al.*, 2018). This leads us to our second proposition towards organisational conduct and strategy:

Proposition 2: In order to promote lean thinking across the organisation, it is important to develop a supportive and organisational strategy which aligns and promotes sustainable cultural changes towards a new mind-set of process improvement.

The last barrier in this level is 'leadership commitment'**.** This addresses the impact of low, medium and top leadership during the lean journey. Some examples of this barrier are the lack of top management's support and commitment (Jadhav *et al.*, 2015), leadership's resistance to change (Lean Enterprise Institute, 2007), and leadership's participation (Emiliani and Stec, 2005). The leadership team conveys the organisation's strategy. They are the ones that influence those

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involved in direct change and encourage change (Drotz and Poksinska, 2014; Tortorella *et al.*, 2018). If leadership is not entirely engaged and presents signs of lack of commitment, this will have a direct impact on 'shop floor' workers, consequently, making the changing process more difficult as there is no reference to follow (Bicheno and Holweg, 2009; Atkinson, 2010). Thus, the leadership team must be selected carefully, considering attributes, such as ownership, demonstration of commitment and enthusiasm towards the change process (Atkinson, 2014; Rise and Haddud, 2016; Nogueira *et al.*, 2018). Leadership style and attitude have a positive impact on the lean journey, and based on this, we derive our third proposition.

Proposition 3: The process of change starts with the definition of a consistent, engaged and motivated leadership team that will convey the organisation's strategy towards those directly performing the lean improvements.

The barriers that appear in the bottom level of the framework are underneath the surface, therefore, they are less visible, and as a result more difficult to identify. These barriers are also dependent on people's behaviour, which means that decisions and strategies do not rely on tools or techniques, but on the strategy defined by people instead. This type of situation was identified by Rise and Haddud (2016) when investigating the impact of organisational culture on small family-owned manufacturing businesses. They found that lean implementation is highly influenced by the values and beliefs of their founders and owners. Furthermore, the impact of corporate culture was also found by Bhasin, (2013b) as a prominent inhibitor of lean success in British manufacturers. In the public service, the organisational structure was also underscored as a strong inhibitor of lean practices (Radnor and Boaden, 2008; Radnor, 2010).

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Organisational conduct is defined by people's individual thinking, attitudes and behaviour that have actions of self-interest to express influence or force (Schilling and Kluge, 2009; Ainul Azyan *et al.*, 2017). This behaviour is people dependent, and it conveys the intangible organisational strategy, which is difficult to identify during the lean journey. From this, we derive our fourth proposition related to barriers placed underneath the surface that are dependent on people:

Proposition 4: The barriers related to behavioural and organisational aspects are dependent on people, therefore, they are more difficult to identify and tackle, and have a huge impact on lean implementation and sustainability.

The upper level of the framework addresses the three barriers related to the 'technical aspects', which are easier to see as they are tool-based barriers. For example, the first barrier in this level is 'technical limitation' which raises obstacles related to knowledge, tools and learning issues. Examples of these barriers are insufficient know-how (Sim and Rogers, 2008), lack of training (DeSanctis *et al.*, 2018), and lack of knowledge (Zimmermann and Bollbach, 2015). There are several critics who state that lean cannot be implemented as a 'tool-based approach' (Spear, 2004; Burgess and Radnor, 2013a), and which is argued leads to piecemeal implementation. However, it is also important to acknowledge that it is essential to provide adequate and effective training on suitable lean methodologies and tools. There are some misunderstandings related to lean, which lead companies to focus only on specific tools or aspects of the implementation, therefore, jeopardizing the potential benefits of a complete lean project across the organisation (Dora *et al.*, 2016b; Panwar *et al.*, 2016; Zhang *et al.*, 2017). The lean approach should not focus

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on replicating specific tools, but equipping employees with a holistic knowledge, so they can act as effective problem-solvers. Therefore, providing training and teaming up with experienced people to deploy lean sustainable initiatives is an enabler to overcome technical limitation (Radnor and Walley, 2008; Bhasin, 2012c; Radnor *et al.*, 2012; Aij *et al.*, 2013b; Escuder *et al.*, 2018). Based on this, we derive our fifth proposition:

Proposition 5: Organisations embarking on the lean journey must avoid excessive focus only on tools and techniques. Instead, they should equip employees with lean holistic knowledge, otherwise lean implementation risks may be fragmented, without a strategy for long-term improvement and sustainability.

The second barrier in this level is 'process-based'. It creates barriers that come from operations, customers and suppliers' interplay. Some examples are difficulties in transferring manufacturing concepts to another industry sector (Gao and Gurd, 2019), uncertainties in demand (Hacker and Doolen, 2005), and poor supplier integration (Dora *et al.*, 2014). These barriers that are 'process-based' can influence how lean is implemented and sustained in different industries. For example, sometimes manufacturers have to deal with demand variability from customers' orders and weak supplier performance. This leads to low standardisation of the operations, and poor integration of the customers and suppliers in the lean project (Wilson and Roy, 2009; Eswaramoorthi *et al.*, 2011; Zimmermann and Bollbach, 2015b). In the service sector, the process is highly affected by customer interaction, also known as co-production (Edvardsson and Olson, 1996; Osborne *et al.*, 2012), and this creates challenges to keep the process standardised, thus affecting the operations. One of the difficulties is to understand customer interactions in the service industry. For instance,

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Grove *et al.* (2010) when investigating a case study in the British public healthcare, found difficulty in determining who the customer was and what they valued . Therefore, to overcome inhibitors that are 'process-based' it is necessary to have clear customer and value identification, as well as supplier integration (Radnor and Boaden, 2008; Machado Guimarães *et al.*, 2013; Jadhav *et al.*, 2014; Cheng *et al.*, 2015). This leads us to our sixth proposition:

Proposition 6: Customers and suppliers are key elements that affect standardised operations in service and manufacturing sectors. Therefore, when implementing lean, the impact of these elements must be identified in the value stream, in order to ease future inhibitors.

The last barrier in this level is 'resource constraints'. The inhibitors in this level involve every type of resource required in the organisation during the lean journey, including availability of time (Nordin *et al.*, 2018), lack of human resources (Marodin and Saurin, 2015), and financial constraints (Caldera *et al.*, 2019). In literature, this is a common obstacle for the lean success. Several scholars agree that the allocation of resources is essential to fund and promote improvement programmes across the organisation (Nordin *et al.*, 2012; Bhasin, 2013b; Kumar and Kumar, 2015; Ainul Azyan *et al.*, 2017; Yadav *et al.*, 2018). Improvement initiatives, such as lean programmes, demand different types of funding. They might come from different areas of the organisation, but in general they involve the investment of time, availability of human resources and financial resources to support the changes needed (Bateman and Rich, 2003; Sisson and Elshennawy, 2015a; DeSanctis *et al.*, 2018). Because resource constraints affect and might hinder lean implementation, it might be regarded as the easiest barrier to identify amongst the technical aspects of the organisational framework (Figure 5). As regards to the strategic

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relevance of the resources, there is a theory that specifically addresses the impact of resources in the organisation, which is the resource-based view (RBV) (Colbert, 2004). RBV scholars argue that when resources are allocated to the right purpose, they enable firms to implement sustainable strategies that represent a competitive advantage for the organisation (Priem and Butler, 2001; Halawi *et al.*, 2005). Thus, based on this consideration, we derive our seventh proposition:

Proposition 7: Resources are essential elements to fund and promote change in the lean journey, therefore, they should be strategically allocated to enable changes and sustainable improvements across the organisation.

The barriers that appear in the upper level of the framework are above the metaphorical surface, and therefore, they are considered visible elements that are easier to identify (Figure 5). In the framework, it is possible to understand that these barriers are usually based on tools and techniques. Reijula and Tommelein (2012) advocate that this type of barrier will be easier to solve in the short-tem, since the need of tools and supplies are easier to identify. This represents an approach on visible elements, that are also known in literature as the 'tool-based approach' and focus on the problem-solving culture (Spear, 2004; Radnor and Walley, 2010; Hines *et al.*, 2011; Burgess and Radnor, 2013). Our study acknowledges that focusing only on these types of barriers might help the implementation in the short-term, but it has a negative impact in the long-term. Therefore, one that is embarking on the lean journey should avoid focusing only on a 'tool-based approach', but should consider a holistic approach instead (Bhasin, 2011; Matthias and Brown, 2016).

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The barriers related to technical aspects are easier to identify in comparison to behavioural and organisational aspects. For example, the lack of resources will be immediately perceived when investment is not made in the lean journey (Jaiprakash Bhamu, 2016; Zhang *et al.*, 2017). Moreover, the difficulties to establish customer and supplier integration, as well as the challenges to implement certain tools and techniques, will make the barriers of technical limitation more visible (Mishra and Chakraborty, 2015; Yadav and Desai, 2017). Nevertheless, this 'tool-based approach' has been criticised in literature, because it creates fragmented implementations, based on tools and technology that are not sustained, rather than create a long-term sustainable strategy for lean (Bhasin and Burcher, 2006; Radnor *et al.*,2012; Reijula and Tommelein, 2012; Burgess and Radnor, 2013a; Coetzee, *et al.*, 2018; Pearce *et al.*, 2018).

This approach that categorises the barriers into behavioural and organisational, as well as technical aspects, echoes other studies that have investigated the impact of these barriers (Bhasin and Burcher, 2006; Nordin *et al.*, 2012; Vienažindienė and Čiarnienė, 2013). Similarly, due to the fact that lean is context dependent, and its implementation should consider contextual elements (Dixon-Woods *et al.,* 2011;Bhasin, 2012a; Radnor and Osborne, 2013), the approach to these barriers should consider both tool-based and people dependent barriers, according to the environment. One of the reasons for the low success factors of lean implementation it could be argued is, to focus on only one side of the framework, i.e. focusing on either visible or less visible elements (Bhasin and Burcher, 2006; Vienažindienė and Čiarnienė, 2013; Tortorella *et al.*, 2017). From this perspective we derive our last proposition based on the interplay of behavioural, organisational, and technical barriers, and their impact on lean journey:

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Proposition 8: These barriers interact and influence each other in different degrees, therefore, to avoid a weak foundation of process improvement programmes, it is important to promote change in both the technical and socio-cultural aspects

The barriers underscored in the framework are not isolated inhibitors, but they have a degree of interplay. The arrows in figure 5 illustrate this relationship between the barriers and levels. For instance, resource constraints might be motivated due to an organisational decision to reduce investments; or a behavioural element, such as resistance to change, might be motivated by a technical limitation that creates frustration towards lean.

In a nutshell, in this section, we tackled the impact and interplay of the six main barriers that constrain the lean journey, providing propositions for each barrier in the organisational framework, which addresses RQ4 of our study.

5. Conclusions

This is a systematic literature review of 204 papers that aimed to identify the main barriers that constrain the lean journey in an organisational framework, identifying their interplay, impact and contribution. These aims have been addressed deriving four research questions that convey the contributions of our study.

In RQ1, we addressed the current outline of lean barriers in literature. This was achieved through the undertaking of a meticulous, descriptive analysis of the data, as suggested by Tranfield *et al.*, (2003). Starting from this analysis, we found key elements that show the main trends in literature, such as the geographic distribution of publications, diversity of the methodological approaches carried out, and type of industry sectors that have encountered lean

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barriers. As regards to the geographic distribution of publications (Figure 2), we found that 47% of the publications were concentrated in three regions: Europe, the Americas and Asia. Even though Europe leads in number of publications, it has a slight difference of only 4% when compared to the other two leading regions. There are other prominent regions with a small number of publications, such as Scandinavia and the Middle East, thus, we understand that these regions represent opportunities for future research, as well as for cross-country studies.

As regard to the methodologies carried out to investigate lean barriers, we found the main methodologies in this order of appearance: literature review, case study, survey, action research, mixed methods and focus group (Figure 3). The results show the prevalence (n=84%) of common methodologies (case study, literature review and survey) as preferable methods to investigate the inhibitors that affect lean implementation and sustainability. Regardless of the prevalence of these three methods, it is important to acknowledge that our research found a plurality of other methods carried out to investigate lean barriers.

Finally, the descriptive analysis addressed the heterogeneity of industry sectors that have investigated lean barriers (Figure 4). We found nine different industry sectors, with a prevalence of studies in the manufacturing sector (n=37%) and healthcare (n=18%). These results confirm the trends in literature; first, it addresses the nature of lean on the shop-floor, and the maturity that lean studies have reached in the manufacturing sector (Womack *et al.*, 1990; Danese *et al.*, 2018); second, it confirms the importance of the healthcare sector as one of the most prominent areas for lean studies (Brandao de Souza, 2009; Mazzocato *et al.*, 2010; Burgess and Radnor, 2013a). Moreover, when considering all industry sectors that could be categorised as 'service', we found that 35% of the studies could be classified in this category. This exemplifies the

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relevance of the service sector for future investigation of lean barriers and challenges (Bowen and Youngdahl, 1998; Leite and Vieira, 2015).

In RQ2, we addressed the meaningful barriers that constrain lean implementation and sustainability. To answer this research question and provide contributions to our study, we carried out a thematic analysis across the literature selected (Tranfield *et al.*, 2003; Braun and Clarke, 2006). Codes and themes emerged from this thematic analysis (Table 1). The codes represent lists of lean barriers found in literature, and from these codes' six themes, which indeed represent meaningful barriers, emerged: 'behavioural and cultural influence', 'organisational strategy and alignment', 'leadership commitment', 'technical limitation', 'process-based', and 'resource constraints' (Table 2). We found a saturation of research related to lean barriers in literature. Most of the studies provide lists of lean barriers that overlap, which is illustrated in Table 1. The first novelty of our study provides meaningful barriers that summarise these overlapping barriers.

In RQ3, we categorised six meaningful barriers in an organisational framework (Figure 5), and in RQ4, we discussed the impact and interplay of these barriers. Thus, from this we derived eight propositions that contribute to knowledge and practice. This provides additional novelty to our study, when compared to similar literature reviews of lean barriers (Bhasin and Burcher, 2006; Nordin *et al.*, 2012; Vienažindienė and Čiarnienė, 2013; Hu *et al.*, 2015; Tortorella *et al.*, 2018; Yadav *et al.*, 2018). Figure 5 illustrates the organisational framework, in which the barriers were separated into two levels of metaphorical surfaces. The barriers underneath the surface represent behavioural and organisational aspects that are people dependent and, therefore, are more difficult to identify and tackle (Schilling and Kluge, 2009; Ainul Azyan *et al.*, 2017). These barriers that are related to behavioural and organisational

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aspects have a major impact on lean implementation and sustainability. Thus, from the literature researched we derived propositions 1, 2, 3 and 4 to address these inhibitors and provide some degree of guidance towards the lean journey.

The barriers above the surface embody technical aspects that are tool-based and, therefore, are easier to identify and tackle. One of the concerns related to barriers in this level is the creation of a culture limited to problem-solving, which might help lean implementation in the short-term, but has a negative impact in the long-term (Spear, 2004; Radnor and Walley, 2010; Hines *et al.*, 2011; Burgess and Radnor, 2013). Thus, based on the literature and data analysis, we derived propositions 5, 6, 7 and 8, to address the impact of these tool-based barriers and encourage a holistic approach to ease lean inhibitors.

A general conclusion is that the aims of this study were achieved, as the research questions were answered and discussed in line with the findings in literature. From the results of this study, we contribute to the discipline of operations management, by providing invaluable theoretical (knowledge and academics) and practical (lean practitioners) contributions. The contributions to knowledge and academics are based on the new body of knowledge related to a categorisation of several common lean barriers into meaningful barriers that have an impact on organisations. Moreover, this work has provided a framework that shows the interplay between barriers and elements within an organisation. Some barriers have a strong influence on the behavioural and organisational aspects, whereas others have an impact on the technical aspects. From this, we derived propositions that tackle these inhibitors, and are basis for further research. inhibitors.

Contributions to lean practitioners consider the impact of these six barriers on lean implementation and sustainability. The results showed that barriers that are dependent on people

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are more difficult to identify and have a great impact on lean. Whilst tool-based barriers are easier to identify and tackle, they also jeopardize the lean journey, creating a fragmented implementation that in the long-term cannot be sustained. Thus, we suggest that lean managers should rethink the way that value is addressed during the implementation and focus on meaningful elements of the organisation that might provide a holistic and sustainable lean implementation.

Furthermore, these contributions together with the research outcome, motivate suggestions for future research on lean barriers. First, we suggest future research addressing the impact of the context in which these barriers emerge. For instance, in the service sector, co-production is a strong element that has an influence on operations. Therefore, behavioural and organisational aspects that are people dependent might present a greater impact in this setting. Whereas, in the manufacturing sector where there is less or no co-production, technical aspects might present greater impact on the lean journey. Second, as some of our finding suggests a shortage of research in some regions, we recommend future research on lean barriers considering different contexts, such as Africa, the Middle East, Oceania and Scandinavia. Third, we suggest in-depth investigations of lean barriers using a different methodological approach, such as Action Research, Focus Group and Mixed Methods. This type of method presented a misrepresentation in our findings; therefore, we believe that research in this area could bring relevant findings. Finally, we suggest further investigation in the healthcare sector, which is an area that is attracting a variety of lean research, and our findings showed that it is a prominent area of services. Therefore, studies in the public and private healthcare that investigate the six main barriers found in this study might bring relevant contribution to knowledge and practice.

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In conclusion, we understand that every piece of research has limitations and strengths. As regards to the limitations, we aimed to find only publications related to predefined keywords in the title, abstract and keywords of the papers. Therefore, it is possible that papers that only presented the predetermined keywords in the body of the article were excluded. Moreover, the terminology related to lean and its barriers might be limited. Although we have predefined the keywords based on literature, for the searching process, it may be possible that we have not considered a different or new terminology related to lean barriers. In this case, we recognize that some publications may have been excluded from our study. Regardless of the limitations of this work, the strengths of the study also present the trustworthiness and rigor of the study. We developed and undertook a meticulous research protocol based on the experience of several scholars that have published a systematic literature review. Therefore, we understand that the rigorous methodology, carried out in this study, creates the trustworthiness of the research and helps to control and ease some of its limitations.

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Meaningful inhibitors of the Lean journey: A Systematic Review and categorisation of over 20 years of literature

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Figure 1 - Framework of the Research Review Protocol

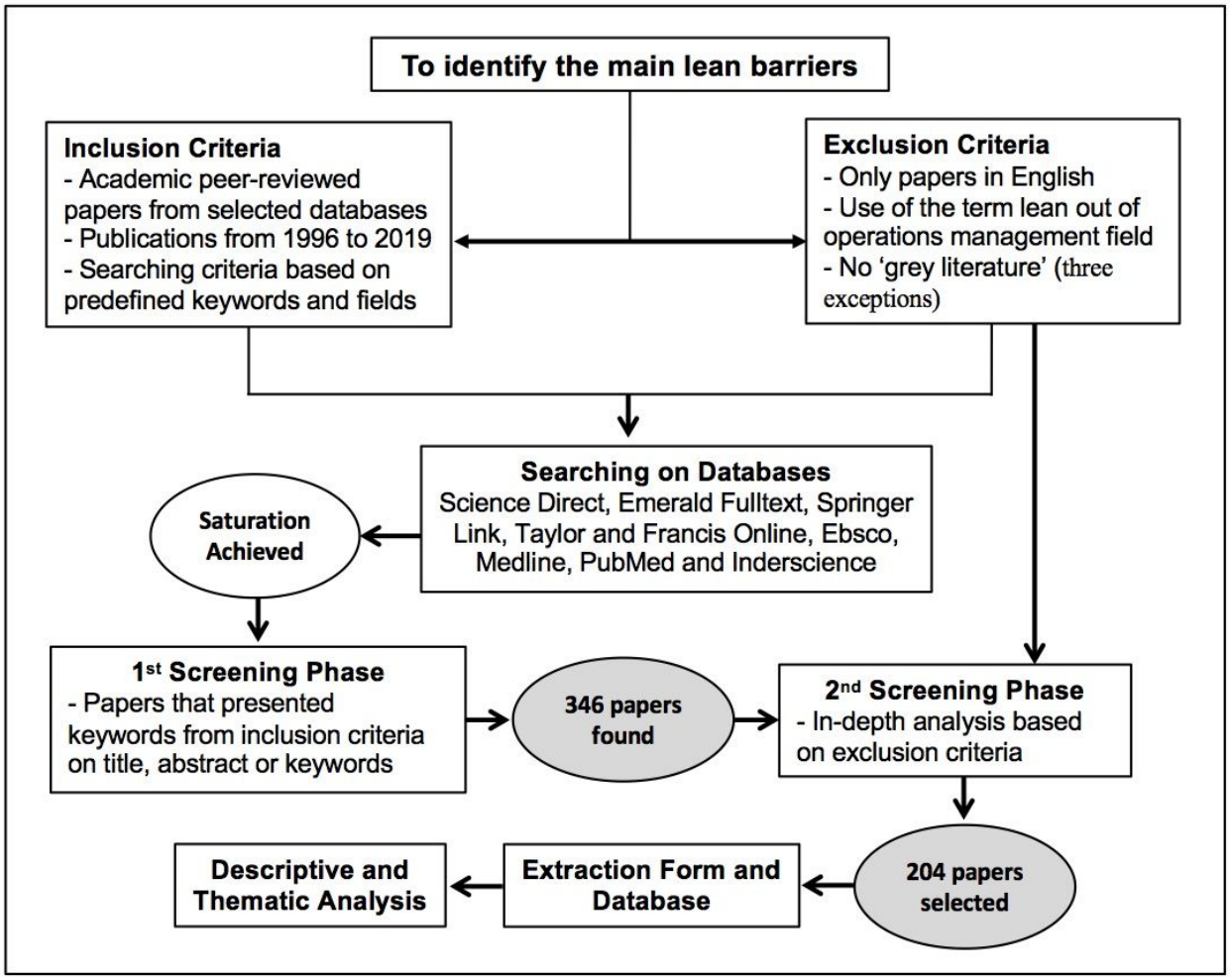

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Figure 2 – Percentage of papers by geographic region

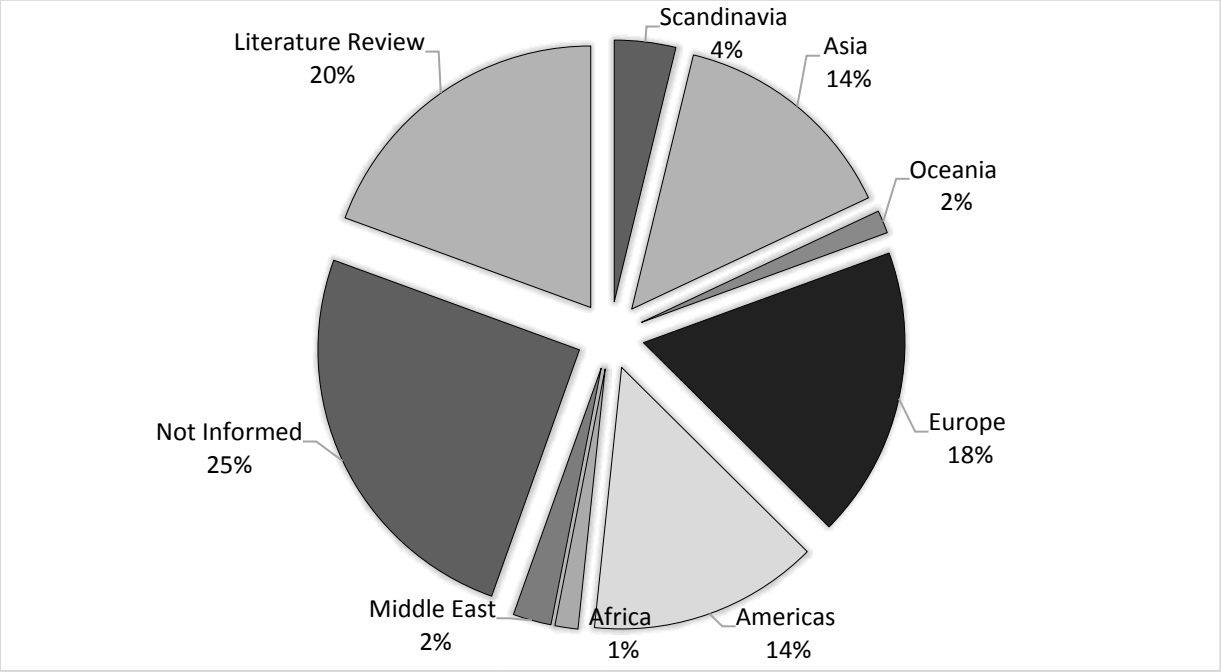

Figure 3 - Percentage of papers by methodology

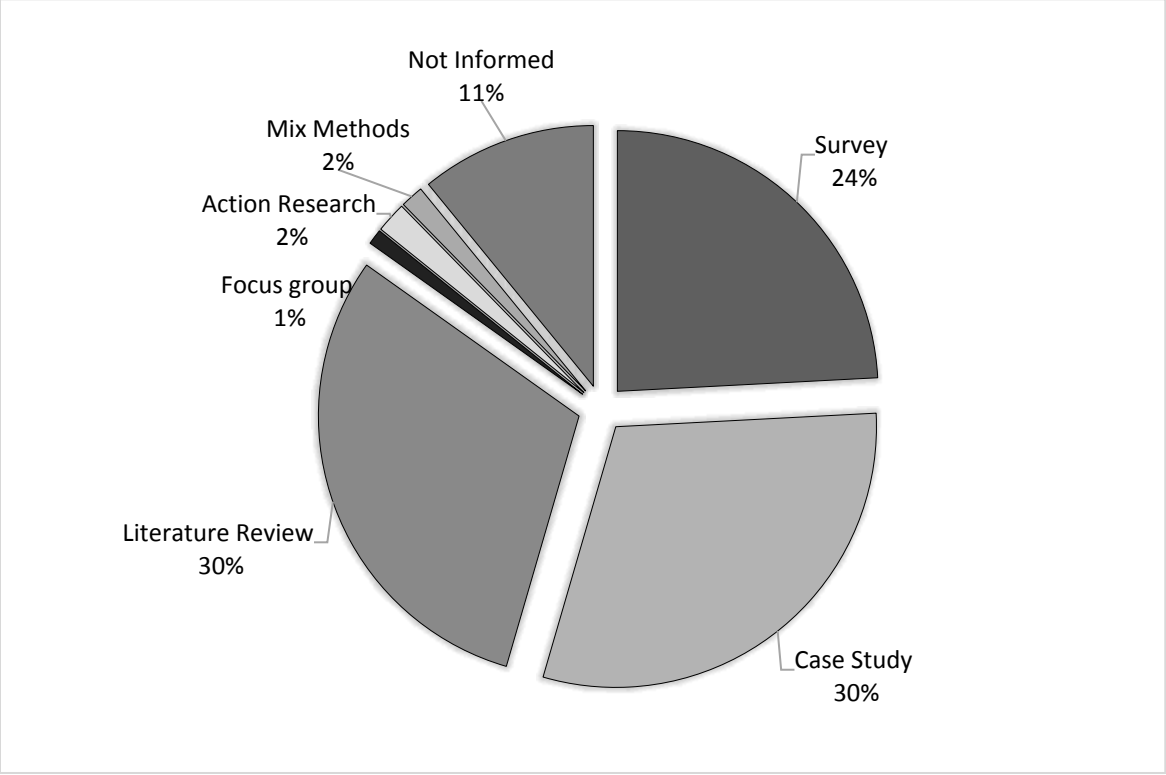

Figure 4 – Percentage of papers by sector

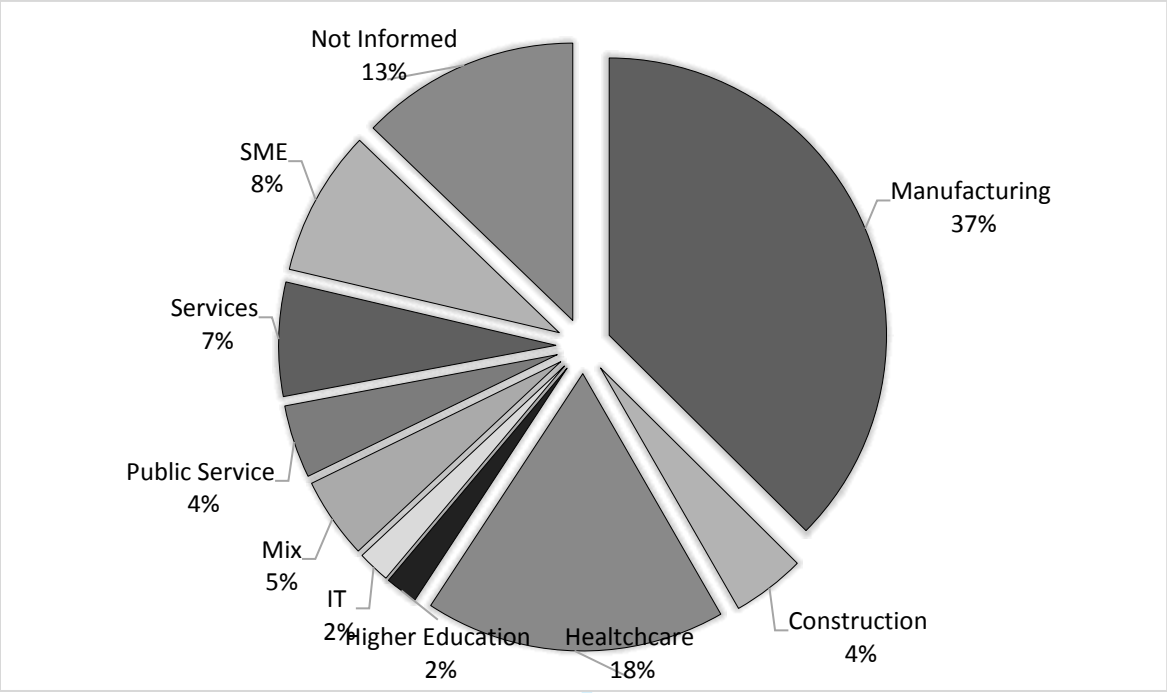

Figure 5 – Organisational framework of the lean barriers

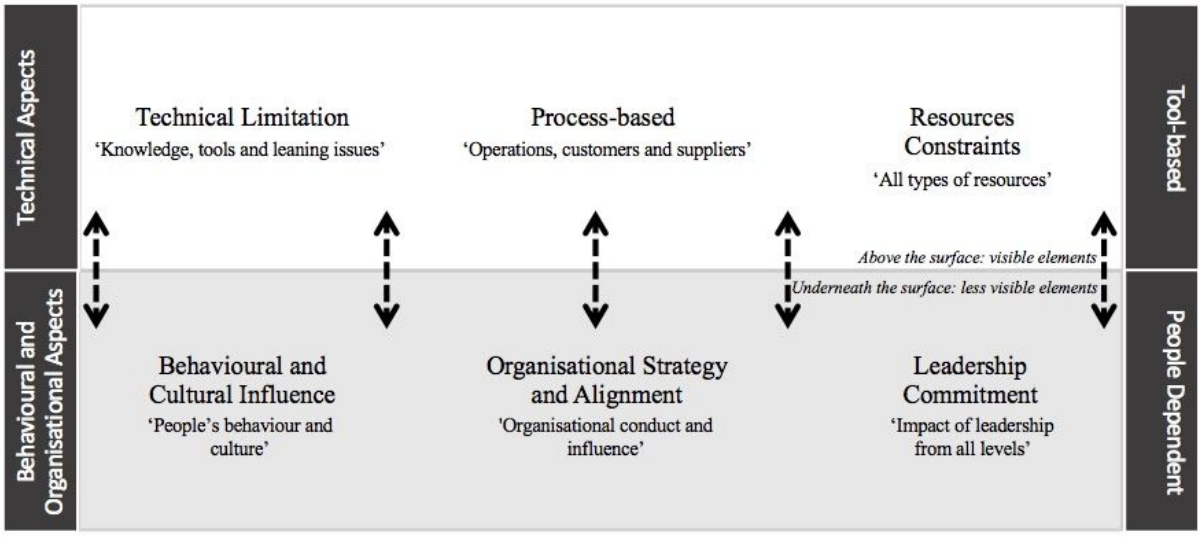

Table 1 – Thematic Analysis – Coding process

Themes	Codes	Sources
Behavioural and cultural influence	• Backsliding to old ways of working; • Cultural issues; • Fear of failure; • Job security; • Lack of interest and commitment; • People-related issues; • Personal conflicts; • Resistance to change; • Social-cultural barriers; • Staff behaviors;	(Barker, 1998; Deloitte and Touche, 2002; Boyer and Sovilla, 2003; Bateman and Rich, 2003; Lucey and Hines, 2005; Canadian Manufactures and exporters, 2006; Kim *et al.*, 2006; Radnor *et al.*, 2006; Radnor and Walley, 2008; Rogers and McQuilkin, 2008; Sim and Rogers, 2008; Fine *et al.*, 2009; Atkinson, 2010; Poksinska, 2010; Angelis *et al.*, 2011; Cudney and Elrod, 2011; de Souza and Pidd, 2011; Hodge *et al.*, 2011; Rossiter *et al.*, 2011; Bhasin, 2011; Nordin *et al.*, 2012; Staudacher and Tantardini, 2012; Aij *et al.*, 2013; Bhasin, 2013; Fernandez-Solis *et al.*, 2013a; Kinder and Burgoyne, 2013; Machado Guimarães *et al.*, 2013; Drotz and Poksinska, 2014; Jadhav *et al.*, 2014; Timmons, *et al.*, 2014; Bhamu and Sangwan, 2014; Zimmermann and Bollbach, 2015; Jasti and Kodali, 2016; Lindskog *et al.*, 2016; Rane *et al.*, 2016; Balzer *et al.*, 2016; Cherrafi *et al.*, 2017; Madsen *et al.*, 2017; Yadav and Desai, 2017; Coetzee *et al.*, 2018; Fournier and Jobin, 2018; Aoun *et al.*, 2018; Pearce *et al.*, 2018; Rexeisen, 2018; Yadav *et al.*, 2018; Belhadi *et al.*, 2018; Henao *et al.*, 2019; Isfahani *et al.*,2019)
Organisational strategy and alignment	• Company strategy; • Communication; • Insufficient understanding of potential benefits; • Lack of alignment; • Lack of long-term strategy; • Organisational barriers; • Organisational culture; • Organisational structure; • Slow pace of change; • Unclear goals and too many targets;	(Emiliani and Stec, 2005; Radnor *et al.*, 2006; Kim and Park, 2008; Radnor and Boaden, 2008; Walley, 2008; Wilson and Roy, 2009; Grove *et al.*, 2010; Atkinson, 2010; Cudney and Elrod, 2011; Vienažindienė and Čiarnienė, 2013; Bhasin, 2013; Albliwi *et al.*, 2014; Kumar and Kumar, 2015; Kumar *et al.*, 2015; Sisson and Elshennawy, 2015; Worley and Doolen, 2015; Anholon and Sano, 2016; Mittal *et al.*, 2016; Dora *et al.*, 2016; Madsen *et al.*, 2017; Rymaszewska, 2017; Yadav and Desai, 2017; Ferenhof *et al.*, 2018; Sreedharan *et al.*, 2018; Stankalla *et al.*, 2018; Wilson *et al.*, 2018; Coetzee *et al.*, 2018; Costa *et al.*, 2018; Leong *et al.*, 2019)
Leadership commitment	• Insufficient supervisory skills; • Lack of awareness amongst managers; • Lack of top management support and commitment; • Leadership resistance to change; • Leadership participation;	(Bateman and Rich, 2003; Boyer and Sovilla, 2003; Emiliani and Stec, 2005; Canadian Manufactures and exporters, 2006; Radnor *et al.*, 2006; Lean Enterprise Institute, 2007; Sim and Rogers, 2008; Wilson and Roy, 2009; Grove *et al.*, 2010; Bhasin, 2011; Wong and Wong, 2011; Hines *et al.*, 2011; Nordin *et al.*, 2012; Staudacher and Tantardini, 2012; Bhasin, 2012; Čiarnienė and Vienažindienė, 2013; Dora *et al.*, 2014; Bateman *et al.*, 2014; Kumar, 2014; Balzer *et al.*, 2015; Gelei *et al.*, 2015; Jadhav *et al.*, 2015; Kumar and Kumar, 2015; Marodin *et al.*, 2015; Mishra and Chakraborty, 2015; Bertani *et al.*, 2015; Winkel *et al.*, 2015; Jaiprakash

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	• Loss of interest by top management; • Managerial style; • Middle management resistance; • Pressure from top management; • Senior management commitment;	Bhamu, 2016; Rafique *et al.*, 2016; Upadhye *et al.*, 2016; Cherrafi *et al.*, 2016; Panwar *et al.*, 2016; Cherrafi *et al.*, 2017; Yadav *et al.*, 2017; Escuder *et al.*, 2018; Khaba and Bhar, 2018; Kregel and Coners, 2018; Muraliraj *et al.*, 2018; Mustapha *et al.*, 2018; Nassereddine and Wehbe, 2018; Nordin *et al.*, 2018; Ruben *et al.*, 2018; Sreedharan *et al.*, 2018; Stankalla *et al.*, 2018; Thanki and Thakkar, 2018; Leong *et al.*, 2019)
Technical limitation	• Education; • Insufficient know-how; • Lack of experience; • Lack of knowledge and expertise; • Lack of methodology; • Lack of workforce skills; • Lean terminology; • Limited lean understanding; • Technology-based; • Training;	(Rogers and McQuilkin, 2008; Sim and Rogers, 2008; De Souza and Pidd, 2011; Deflorin and Scherrer-Rathje, 2012a; Reijula and Tommelein, 2012; Fernandez-Solis *et al.*, 2013b; Machado Guimarães *et al.*, 2013; Bhasin, 2013; Čiarnienė and Vienažindienė, 2013; Dora *et al.*, 2014; Hadid and Mansouri, 2014; Albliwi *et al.*, 2014; Jadhav *et al.*, 2014; Kumar, 2014; Marodin and Saurin, 2015; Mishra and Chakraborty, 2015; Bertani *et al.*, 2015; Worley and Doolen, 2015; Zimmermann and Bollbach, 2015; Chay *et al.*, 2015; Abolhassani *et al.*, 2016; Deblois and Lepanto, 2016; Hadid, *et al.*, 2016; Jasti and Kodali, 2016; Ainul Azyan *et al.*, 2017; Yadav and Desai, 2017; Zhang *et al.*, 2017; De Oliveira *et al.*, 2018; DeSanctis *et al.*, 2018; Edison *et al.*, 2018; Hihnala *et al.*, 2018; Lauver *et al.*, 2018; Alkhoraif *et al.*, 2018; Nassereddine and Wehbe, 2018; Nogueira *et al.*, 2018; Ramadas and Satish, 2018; Ruben *et al.*, 2018; Stankalla *et al.*, 2018; Vlachos and Siachou, 2018; Weerasooriya *et al.*, 2018; Costa *et al.*, 2018; Piyathanavong *et al.*, 2019; Sindhwani *et al.*, 2019; Caldera *et al.*, 2019)
Process-based	• Fragmented implementation; • Lack of focus on customer and process; • Lack of metrics; • Lack of standardization; • Market factors; • Operational hurdles; • Poor supplier integration; • Regulation polices (bureaucracy); • Transferring manufacturing concepts into another industry • Uncertainties in demand;	(Arkader and Janeiro, 2001; Deloitte and Touche, 2002; Hacker and Doolen, 2005; Radnor and Walley, 2008; Radnor and Boaden, 2008; Scorsone, 2008; Young and McClean, 2009; Radnor, 2010; Suárez-Barraza and Ramis-Pujol, 2010; Poksinska, 2010; Grove *et al.*, 2010; Wong and Wong, 2011; Eswaramoorthi *et al.*, 2011; Deflorin and Scherrer-Rathje, 2012a, 2012b; Machado Guimarães *et al.*, 2013; Jadhav, *et al.*, 2014; Rymaszewska, 2014; Dora *et al.*, 2014; Sisson and Elshennawy, 2015; Zimmermann and Bollbach, 2015; Matthias and Brown, 2016; Cherrafi *et al.*, 2016; Sahai, Virmani and Saha, 2017; Pearce *et al.*, 2018; Rexeisen *et al.*, 2018; Tezel *et al.*, 2018; Thanki and Thakkar, 2018; De Oliveira *et al.*, 2018; Yadav *et al.*, 2018; Caldera *et al.*, 2019; Isfahani *et al.*, 2019; Sindhwani *et al.*, 2019; Gao and Gurd, 2019)
Resources constraints	• Budget constraints; • Financial	(Er *et al.*, 2000; Bateman and Rich, 2003; Canadian Manufactures and exporters, 2006; Radnor *et al.*, 2006; Lean

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	constraints; • Funding constraints; • High cost; • Insufficient external funding; • Lack of equipment; • Lack of human resources; • Lack of internal funding; • Resources constraints; • Time availability;	Enterprise Institute, 2007; Radnor, 2010; Bhasin, 2011; Eswaramoorthi *et al.*, 2011; Timans *et al.*, 2012; Bhasin, 2012, 2013; Vienažindienė and Čiarnienė, 2013; Albliwi *et al.*, 2014; Jadhav *et al.*, 2015; Marodin *et al.*, 2015; Sisson and Elshennawy, 2015; Mittal *et al.*, 2016; Jaiprakash Bhamu, 2016; Cherrafi *et al.*, 2016; Balzer *et al.*, 2016; Cherrafi *et al.*, 2017; Ainul Azyan *et al.*, 2017; Soliman and Saurin, 2017; Zhang *et al.*, 2017; Albliwi *et al.*, 2017; DeSanctis *et al.*, 2018; Edison *et al.*, 2018; Khaba and Bhar, 2018; Muraliraj *et al.*, 2018; Raval *et al.*, 2018; Sahoo and Yadav, 2018; Tiwari and Tiwari, 2018; Yadav *et al.*, 2018; Piyathanavong *et al.*, 2019; Caldera *et al.*, 2019)

Table 2 – Thematic Analysis Frequency

Main Themes	Frequency
Behavioural and Cultural Influence	22.14%
Organisational Strategy and Alignment	21.84%
Technical Limitation	19.18%
Process-based	13.57%
Leadership Commitment	12.86%
Resources Constraints	10.41%

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