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Abstract

The term 'Lean Six Sigma' refers to the integration of 'Lean' and 'Six Sigma' business improvement methodologies, where 'Lean' is a process improvement methodology used to deliver products and services better, faster and at a lower cost, while 'Six Sigma' is a data-driven methodology used to achieve stable and predictable processes. The concept of 'Lean Six Sigma' as an integrated strategy is still in development: since its inception in 2000, a number of academics have developed an integrated approach, while others have focused on a framework for the successful integrations of Lean and Six Sigma. Despite becoming the most popular business strategy for deploying continuous improvement, many organizations are struggling to turn Lean Six Sigma into a success, citing lack of leadership, changing business focus, internal resistance and availability of resources as the main impeding factors. The focus of this research was to consolidate the existing knowledge on leadership and Lean Six Sigma, providing a starting point for researchers and practitioners seeking to implement Lean Six Sigma in organizations and offering suggestions for future research.

This systematic literature review aims to synthesize, organize and structure the stock of knowledge relating to Lean Six Sigma and leadership. The research is based on a systematic literature review of 179 papers that were published on leadership, Lean and Six Sigma in well-known academic databases in the past 20 years. The key findings of the review show that: (1) Leadership is a requirement for successful Lean Six Sigma deployment in organizations, and critical to sustaining improvement; and (2) Lean Six Sigma is an effective leadership development tool. Leadership is a critical factor for Lean Six Sigma success and there is the need to develop a new model of leadership that encompasses the leadership traits needed for Lean Six Sigma.

Keywords: Lean, Six Sigma, Lean Six Sigma, leadership, systematic literature review

1 Introduction

This systematic literary review aims to synthesize, organize and structure the stock of knowledge relating to Lean Six Sigma and leadership. The review focuses primarily, but not exclusively, on theoretical developments and empirical studies in the practice of Lean Six Sigma.

The term 'Lean Six Sigma' started to be used in 2000 as a way to describe the integration of Lean and Six Sigma philosophies (Sheridan, 2000). Lean Six Sigma is a business improvement methodology that aims to maximize shareholders' value by improving quality, speed, customer satisfaction and costs: it achieves this by merging tools and principles from both Lean and Six Sigma (Albliwi, Antony, & Lim, 2015; Lee & Wei, 2009; Chen & Lyu, 2009; Chakravorty & Shah, 2012; Vinodh, Kumar, & Vimal, 2012).

Lean and Six Sigma have followed independent paths since the 1980s, when the terms were first hard-coded and defined: Lean originated in Japan (within the Toyota production system), and Six Sigma first saw the light in the USA (within the Motorola Research Centre). Lean is a process improvement methodology used to deliver products and services better, faster and at a lower cost. Womack and Jones (1996) defined it as:

a way to specify value, line up value-creating actions in the best sequence, conduct those activities without interruption whenever someone requests them, and perform them more and more effectively. In short, lean thinking is lean because it provides a way to do more and more with less and less—less human effort, less human equipment, less time, and less space—while coming closer and closer to providing customers with exactly what they want.

Six Sigma is a data-driven process improvement methodology used to achieve stable and predictable process results, reducing process variation and defects. Snee (1999) defined it as ‘a business strategy that seeks to identify and eliminate causes of errors or defects or failures in business processes by focusing on outputs that are critical to customers’.

While Lean is all about speed and efficiency, Six Sigma is concerned with precision and accuracy: Lean ensures resources are working on the right activities while Six Sigma ensures things are done right the first time. The term ‘Lean Six Sigma’ was first introduced in the literature in 2000 (Timans, Antony, Ahaus, & Solingen, 2012), and has increased in interest and popularity, both in small- and medium-sized manufacturing businesses (Kumar, Antony, Singh, Tiwari, & Perry, 2006) and in large organizations, such as **Motorola, General Electric and Honeywell** (Laureani & Antony, 2012; Timans et al., 2012). Snee (2010) defined Lean Six Sigma as ‘a business strategy and methodology that increases process performance resulting in enhanced customer satisfaction and improved bottom-line results’, arguing that it was unproductive to debate whether Lean or Six Sigma was more applicable to solve specific issues, while focusing instead on how to combine them best to address the problem at hand. The benefits of Lean Six Sigma in the industrial world (in both manufacturing and services sectors) have been highlighted extensively in the literature (Zhang, Irfan, Khattak, Zhu, & Hassan, 2012) and include (Antony, 2005a, 2005b): ensuring services/products conform to what the customer needs (‘voice of the customer’), removing non-value adding steps (waste) in critical business processes, reducing the cost of poor quality, reducing the incidence of defective products/transactions, shortening the cycle time and delivering the correct product/service at the right time in the right place.

The concept of Lean Six Sigma as an integrated strategy is still in development in the literature. Since its inception in 2000, a number of academics have developed an integrated approach (Thomas, Rowlands, Byard, & Rowland-Jones, 2008; Snee & Hoerl, 2007; Pepper & Spedding, 2010), while others have focused on a framework for the successful integration of Lean and Six Sigma (Alsmadi & Kahn, 2010; Bendell, 2006; Salah, Rahim, & Carretero, 2010; Hardeman & Goethals, 2011). While Pepper (2007) individuated the need for a closer integration of Lean and Six Sigma in order to drive a unified methodology forward, Snee (2010) focuses on how Lean Six Sigma is a holistic improvement methodology addressing the flow of information and materials through processes, as well as the enhancement of value-adding process steps to create the product for the customer (Timans et al., 2012): in his view, this will naturally lead to making improvement a business process similar to any other important business process.

Overall, there is a noticeable increase in the popularity of Lean Six Sigma in the industrial world, particularly in larger organizations in western countries (USA, UK, Netherlands) and some small- and medium-sized manufacturing enterprises (SMEs) in developing countries such as India (Albliwi et al., 2015), although the theoretical foundations are still developing (Pepper & Spedding, 2010).

Lean and Six Sigma have become the most popular business strategies for deploying continuous improvement in manufacturing, service and public service organisations (Albliwi et al., 2015). Continuous improvement is the main aim for any organization to help them to achieve quality and operational excellence and to enhance performance (Thomas, Barton, & Okafor, 2009; Assarlind, Gremyr, & Backman, 2012).

However, despite its success in some organizations, others are struggling to turn Lean Six Sigma into a success, citing a lack of leadership, changing business focus, internal resistance

and availability of resources as the main impeding factors (Timans et al., 2012), with Snee (2010) pointing out how Lean Six Sigma is an effective leadership development tool: ‘leaders enable an organization to move from one paradigm to another; from one way of working to another way of working. Lean Six Sigma provides the concepts, methods and tools for changing processes’. Given this scenario, we believe an updated systematic literature review on leadership and Lean Six Sigma is needed. As research in this field is still in development, with fragmented and diverse studies, it would benefit significantly from a study aimed at understanding and reorganizing the available knowledge around leadership and Lean Six Sigma. This review also makes an important methodological contribution by applying elements of systematic reviews originating from the so-called ‘hard sciences’ to the leadership and Lean Six Sigma studies field, where there is little systematic research and concepts are often poorly operationalized, often meaning a failure to provide enough help to organizations in their efforts to deploy Lean Six Sigma.

The focus of this research was to consolidate the existing knowledge on leadership and Lean Six Sigma, providing a starting point for researchers and practitioners seeking to implement Lean Six Sigma in organizations and offering suggestions for future research. Several new leadership styles have been proposed in the past decade (Anderson & Sun, 2015), but they haven’t been yet properly defined: there is a need to develop a new model of leadership that encompasses the leadership traits needed for Lean Six Sigma. This will also have managerial implications, helping organizations that are about to embark on a Lean Six Sigma journey to ensure they have the right leadership in

The paper is structured as follows: the next section describes the methodological approach used to conduct the systematic literature review; then we analyse the data collected. Finally, we provide a critical discussion of the results, with suggestions for future research.

2 Methodology

The approach used to conduct the review is the one of systematic review. Systematic reviews in management research are relatively new (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004; Tranfield, Denyer, & Smart, 2003): they have been used in a range of health, social care and education fields in order to synthesize research in an orderly and transparent way (Tranfield, Denyer, & Smart, 2002). A systematic review is a structured process used to investigate the background literature, which aims to avoid potential pitfalls arising from a purely narrative analysis (Pittaway, Robertson, Munir, Denyer, & Neely, 2004), while providing an audit of the decisions and conclusions of the reviewers, increasing transparency and enabling the replication of the research considered (Thorpe, Holt, MacPherson, & Pittaway, 2005).

The adopted systematic review procedures outlined by Tranfield et al. (2003) comprise three stages of review process:

1. Review planning, in which we define what is in the scope of the review, the review protocol (including explicit description of various steps in review process), the key data collection method, the search strategy for the identification of relevant studies, and the inclusion and exclusion criteria. These explicitly aim to limit systematic error and bias (Petticrew & Roberts, 2006).
2. Review execution includes the collection and organization of data, data processing and classification, and data synthesis. Data collection is carried out with a predefined selection algorithm using predefined search strings.
3. Reporting, where the results are synthesized and their consequences examined.

In the review planning we decided to focus the scope of our systematic review on the Lean and Six Sigma methodologies for quality and continuous improvement, and leadership effects.

In the review execution phase, the search strategy aimed to eliminate bias and be as widespread as possible, by using a database search and cross-referencing between papers.

The review focused on double-blind peer-reviewed journal articles, which can be considered as valuable knowledge (Podsakoff, MacKenzie, Bachrach, & Podsakoff, 2005), and influential journals tend to shape theoretical and empirical work (Furrer, Thomas, & Goussevskaia, 2008); however, we also included relevant text books, conference proceedings and academic dissertations.

The following keywords, in the fields of 'title' and/or 'abstract' in English, were searched:

- Leadership and/or Lean
- Leadership and/or Six Sigma
- Leadership and continuous improvement

These keywords correspond to the main fields of studies in which we have investigated a relationship. References at the end of each paper were used to dive deeper into the literature; further searches in key journals were used to supplement the initial search to identify articles that might have been missed in the initial search. Reminder alerts were also set on the systems so as to be immediately informed of a new relevant article being published: this allowed the systematic review to be very up to date with the literature in the Lean Six Sigma field. Thus we tried to 'retrieve everything of relevance, while leaving behind the irrelevant' (Petticrew & Roberts, 2006, p. 81).

The list of peer-reviewed journal articles were obtained from ABI/INFORM Complete, Omnifile Full-Test, ASSIA (Applied Social Sciences Index and Abstracts), Informa – Taylor & Francis, JSTOR, ScienceDirect, Springer, Wiley, Athena, Shibboleth, Google Scholar, EBSCO, Primo Central and Emerald Insights, as they cover the entire management and quality-related fields. We began our search by identifying publications with ‘Leadership Lean Six Sigma’ as keywords, as these words reflect our scope of review, with searches limited to the English language.

The initial search returned 610 papers: we then excluded those papers from journals focusing on areas other than management or quality, books, dissertations and conference proceedings. Further searches in key journals were used to supplement the initial search to identify articles that might have been missed in the initial search. In order not to miss any relevant articles that are within our inclusion and exclusion criteria, we cross-checked with earlier reviews and included those papers that are within our criteria. We also carried out manual searches of numerous reference lists from the selected papers to identify additional relevant papers that fall under our selection criteria. We ended up with 285 papers with these inclusion and exclusion criteria.

We then filtered these papers for articles linked to leadership, Lean, Six Sigma, Lean Six Sigma, continuous improvement, and quality, and we excluded the following: papers dealing with Six Sigma models for implementation; papers dealing with statistical domains; and papers dealing exclusively with the tools and techniques of Six Sigma and industrial case studies demonstrating Six Sigma improvement projects. By going through each abstract, we finally identified relevant articles to match our inclusion criteria and the scope of our study and this systematic and rigorous selection identified 179 publications (full list in the appendix). Figure 1 shows our selection procedure.

INSERT FIGURE 1

Figure 1 Systematic review selection and review procedure adapted from Arumugam et al. (2014)

Since the objective of our systematic literature review is to review and synthesize the literature, rather than to consolidate the findings empirically, we limit our methodology to descriptive and qualitative analysis. Therefore we carried out interpretative synthesis (Dixon-Woods et al., 2006) and qualitative analysis (Bronson & Davis, 2012).

3 Results and analysis

This systematic literature review is based on a sample of 179 papers (full list in the appendix) composed as follows: 146 conceptual papers, 14 empirical studies, 12 literature reviews and seven exploratory studies. In this section, we present data collected with the aim of providing an updated picture of the status of current literature on leadership and Lean Six Sigma. Since the main objective of our review was to bring out a broad theoretical understanding of the relationship between leadership and Lean Six Sigma, we classified the selected papers on the basis of their research focus, the research methods, year of publication, geography and application sector (manufacturing, service or public sector).

3.1 Publication distribution

Year of publication

The distribution of papers over time show academic interest for the subject increased over time, reaching the most output in the second half of the last decade (Figure 2).

INSERT FIGURE 2

Figure 2 Number of relevant articles by time period

Publications on leadership and Lean Six Sigma grew over time, as Lean Six Sigma itself moved from a niche to a mainstream management technique, peaking around 2009–2010.

Journals

Most of the papers were published in the following five journals: *Quality Progress*, *International Journal of Quality & Reliability Management*, *International Journal of Six Sigma and Competitive Advantage*, *Harvard Business Review* and *Total Quality Management & Business Excellence*. Papers were also found in journals dedicated to a variety of fields (e.g. healthcare, engineering, operation management), signalling the dissemination of the topic in contexts and disciplines different from the original manufacturing or quality setting. In total, 97 journals were used for this study and Table 1 lists the journals with two or more articles.

INSERT TABLE 1

Table 1 Journals with two or more papers in our literature review

3.2 Research context

This sub-section analyses the data collected around the sector and country of the research. For each paper it was determined whether there was a dominant industrial sector or country on which the research was based. The majority of papers were not affiliated to a specific industrial sector, but examined the subject at a more theoretical, conceptual level. However, it was noticeable that Lean Six Sigma has grown in publications related to healthcare: a clear sign of how it has ventured outside the more traditional manufacturing sector to tackle problems elsewhere. Considering the countries where research took place, the USA was the

country with by far the most papers (approximately 20%), while the rest of papers were spread equally across the UK, continental Europe and India.

The vast majority of papers were conceptual in nature, describing some aspect of the Lean Six Sigma methodology and its possible applications. This is not a surprise, as often industry practitioners are unable to publish their results due to a company's non-disclosure rules or concerns about confidentiality and competitiveness; hence, inevitably, a literary review is always more biased towards theoretical publications.

The next part of the systematic literature review process is the synthesis (Dixon-Woods et al., 2006): it involves an in-depth qualitative analysis of each research study selected for review, inclusive of all aspects of the research process, related findings and interpretations made from the primary research (Bronson & Davis, 2012).

4 Discussion

4.1 Leadership theories

The importance of leadership has often been emphasized in the area of quality management. Despite such consideration, little has been espoused regarding the theoretical mechanisms by which leadership and Lean Six Sigma are related: this paper provides a focus on such issues with the hope of stimulating more systematic research efforts. Emphasis is placed on the mutual influence of leadership and organizational culture on the deployment of Lean Six Sigma.

The definition of 'leadership' abounds in the literature. In 1991, 54 leadership experts from 38 countries agreed on a common definition of leadership as 'influencing, motivating, and enabling others to contribute toward the effectiveness and success of the organizations of which they are members' (House, Javidan, & Dorfman, 2001). Most of the literature on

leadership can be organized into the following five leadership theories (Kanungo, 1998; Yukl, 2006):

1. *Behavioural perspective* identifies two clusters of leaders' behaviour: people-oriented and task-oriented.
2. *Contingency perspective* says effective leaders adapt their styles to the situation.
3. *Competency perspective* tries to identify the characteristics of effective leaders.
4. *Transformational perspective* says that leaders create and communicate a vision.
5. *Implicit leadership perspective* says the importance of leadership is inflated.

It is important to note that, no matter which theory one wants to follow, all agrees that leaders exist everywhere in the organization, not just on the executive board (McShane & Von Glinow, 2008).

Behavioural perspective

Originally only four leadership styles were identified (Lewin, Lippitt, & White, 1939):

1. Dictator
2. Autocratic
3. Participative
4. Laissez-faire

In the 1940s and 1950s many studies were carried out to determine which leadership behaviours made leaders more effective; the results clustered the various behaviours around two poles, the task-oriented and the people-oriented (Northouse, 2004; Yukl, 2006).

These two extremes are clearly generalizations useful in theory, but rarely in practice is a leader either completely task-oriented or completely people-oriented. This dichotomy also assumes that high levels of both extremes are best in all situations, while in reality the best leaders' behaviour may depend on the situation (Kerr et al., 1974), as stated by the contingency theorists of leadership.

Contingency perspective

Among the contingency theories, the 'path-goal' theory (based on the expectancy theory of motivation (Isaac, Zerbe, & Pitt, 2001) is the one that has stood the test of time. It has the merit of having introduced the concept of servant leadership – that is, the belief that leaders serve followers by understanding their needs and facilitating their work performance (Spears & Lawrence, 2002). The path-goal leadership theory advocates four leadership styles:

1. *Directive*: the leader dictates goals and standards.
2. *Supportive*: the leader is approachable and friendly, supporting followers.
3. *Participative*: followers are involved in setting goals and standards.
4. *Achievement oriented*: the leader sets challenging goals and strives for continuous improvement.

Other contingency theories include:

- situational leadership theory, developed by Hersey and Blanchard (1988), which suggests that leaders adapt their styles based on the 'readiness' of their followers;
- Fiedler's contingency model (Fiedler, 1967), where leadership effectiveness depends on whether the person's natural leadership style is appropriately matched to the situation; and

- leadership substitute theory (Schriesheim, 1997), which identifies conditions that limit a leader's effectiveness and advocates that leaders help followers to lead themselves.

Competency perspective

The idea of identifying personality traits more conducive to effective leadership is a cornerstone of the competency theory. Ilies, Gerhardt and Le (2004) individuated the following personality traits as important to be an effective leader:

1. Emotional intelligence
2. Integrity
3. Drive
4. Leadership motivation
5. Self-confidence
6. Intelligence
7. Knowledge of the business

Transformational perspective

Burns (1978) defines transformational leaders as agents of change, creating, communicating and modelling a vision for the team or organization, inspiring followers to that vision.

Opposite to this is transactional leadership, helping organizations to achieve their current objective more efficiently (Goodwin, Wofford, & Whittington, 2001). For a while, charismatic leadership was used as a synonym of transformational leadership, but ultimately

it came to be considered as a separate leadership perspective, using referent power over followers to establish itself (Barbuto, 1997).

Implicit leadership perspective

The four types of leadership theories reviewed so far (competency, behavioural, contingency and transformational) all have in common the underlying assumption that a leader can make a difference in an organization. On the contrary, the last type of leadership theory, the implicit one, considers the importance of leadership as inflated, seeing its origin in the human need for control (Meindl, 1990).

Level 5 and Six Sigma leadership

Recently two new theories of leadership have been introduced: Level 5 leadership (Collins, 2001b) and Six Sigma leadership (Pande, 2007). Level 5 leaders display compelling humility, putting the organization's interests ahead of their own, a strong powerful commitment, and the capacity to bring out the best in others: they are a mix of personal humility and iron will. Six Sigma leadership is based on the idea that leadership is a learnable combination of skills that combine balance and flexibility to drive performance; data drive decisions and a constant customer focus are among the most important characteristics of the Six Sigma leader.

4.2 Leadership traits and styles

Table 2 summarizes the leadership traits from the literature review for the ten different styles of leadership (Tannenbaum & Schmitt, 1958; Hofstede, 1977; Schriesheim, 1982; Stodgill, 1989; Bass, 1990; Kouzes & Posner, 1987), defined as follows.

INSERT TABLE 2

Table 2 Leadership traits by leadership style

Level 5

The Level 5 leader sits on top of a hierarchy of capabilities and builds enduring company greatness through a paradoxical combination of personal humility plus professional will (Collins, 2001a). Level 5 leaders routinely credit others, external factors and good luck for their company's success, but when results are poor, they blame themselves. They also act quietly, calmly and determinedly, relying on inspired standards, not charisma, to motivate. Utterly intolerant of mediocrity, they are stoic in their resolve to do whatever it takes to produce great results. They also select great successors for themselves, wanting their organization to be even more successful in the future (Collins, 2001b).

Affiliative

This is a leadership style where the leader promotes harmony among his or her followers and helps to resolve any conflict. This type of leader will also build teams that make sure that their followers feel connected to each other. Affiliative leaders value people and their feelings, put less emphasis on accomplishing tasks and goals and more on the emotional needs of employees. They keep people happy, emphasise harmony and build team resonance. Typically the followers will receive much praise from this style of leader; however, poor performance tends to go unchecked (Goleman, Boyatzis, & McKee, 2002).

Bureaucratic

This is a style of leadership that emphasizes procedures and historical methods regardless of their usefulness in changing environments. Bureaucratic leaders attempt to solve problems by adding layers of control, and their power comes from controlling the flow of information (Weber, 1905). A bureaucratic leader is subject to a system of behavioural rules and technical rules. Behavioural rules define the scope of a manager's behaviour and constraint his conduct, while technical rules control how work is to be performed and how decisions are

made (Meier, 1989). Weber (1905) described the six main characteristics of bureaucratic leadership in this way:

1. A strict hierarchy that is formalized by the leadership and strictly adhered to.
2. The organization is controlled by immutable rules, regulations or laws.
3. The organization is structured along the lines of specialities. People with like talents are grouped together.
4. The organization has one of two missions:
 - ‘Up-focus,’ meaning it focuses on the board of directors or stockholders;
 - ‘In-focus,’ which means the organization serves a product-oriented goal such as increasing profits market share.
5. Bureaucratic leadership is impersonal. It is about performance, not the worker.
6. Employment is based on the most technically proficient.

Participative

Also known as the democratic style, the participative leader involves subordinates in goal setting, problem solving, team building and so on, but retains the final decision-making authority (Lewin et al., 1939). The idea that participative leadership is likely to enhance the performance of subordinates was suggested by Barnard (1938) decades ago, and has been expanded and developed subsequently by many researchers (Huang, Iun, Liu, & Gong, 2010). Two theoretical models underline the effects of participative leadership behaviour on subordinates’ work performance: the motivational model and the exchange-based model. The first suggests that increasing the degree in which subordinates participate in decision making

may increase performance through enhanced motivation (Sashkin, 1976). The exchange-based model, based on social exchange theory (Blau, 1964), suggests that when employees are treated well by their superiors, they are more likely to reciprocate by showing high levels of work performance (Blau, 1964).

Servant

This style stresses the importance of the role a leader plays as the steward of the resources of a business or other organization, and teaches leaders to serve others while still achieving the goals set by the business (Greenleaf, 1977). Servant leaders begin with the natural feeling of serving first, to ensure that others' 'highest priority needs are served first' (Greenleaf, 1970, p. 4). Various studies (Barbuto & Wheeler, 2006; Dennis & Bocarnea, 2005; Liden, Wayne, Zhao, & Henderson, 2008; Russell & Stone, 2002; Sendjaya, Sarros, & Santora, 2008; Van Dierendonck & Nuijten, 2011) have developed measures for servant leadership, which have elicited 43 overlapping dimensions. Anderson & Sun (2015) synthesized these in the following 12 conceptually distinct dimensions.

1. *Altruistic calling* is a leader's deep-rooted desire and spiritual purpose to make a positive difference in others' lives through service (Barbuto & Wheeler, 2006).
2. *Persuasive mapping* describes the extent to which leaders uses sound reasoning and mental frameworks to map issues and conceptualize greater possibilities for the future (Barbuto & Wheeler, 2006; Liden et al., 2008).
3. *Courage* is the ability to see things differently and take risks with new ways to deal with old problems (Van Dierendonck & Nuijten, 2011).

4. *Agapao love* is moral (Dennis & Bocarnea, 2005) and unconditional, and considers the whole person rather than treating them as a means to an end (Russell & Stone, 2002).
5. *Emotional healing* can help in the spiritual recovery from hardship and trauma when individuals' dreams, aspirations, hopes and relationships are broken (Barbuto & Wheeler, 2006).
6. *Forgiveness* is the ability to let go of perceived wrong doings and not carry past grudges into other situations (Van Dierendonck & Nuijten, 2011).
7. *Humility* is the understanding of one's own strengths and weaknesses, putting one's strengths in proper perspective (Dennis & Bocarnea, 2005).
8. A *covenantal relationship* is developed by accepting individuals as they are, engaging with them as equal partners, and displaying open-ended communication and trust (Sendjaya et al., 2008).
9. *Behaving ethically* means holding oneself to high moral standards and always acting with moral integrity (Liden et al., 2008; Sendjaya et al., 2008).
10. *Authenticity* is being true to oneself, accurately reflecting both public and private selves (Van Dierendonck & Nuijten, 2011).
11. *Creating value for the community* is the extent to which leaders prepare an organization to make a positive contribution to society (Barbuto & Wheeler, 2006; Liden et al., 2008).
12. *Accountability* is holding followers accountable to deliver on what they can control (Van Dierendonck & Nuijten, 2011).

Six Sigma

This style advocates a higher standard of leadership effectiveness through the foundational principles of Six Sigma, and is a model anyone can aspire to regardless of whether the company uses Six Sigma or not (Pande, 2007). The combination of stability (balance) and responsiveness (flexibility) makes a Six Sigma leader: rather than focusing on traits like charisma, the core of Six Sigma leadership is about practical skills and principles that can be applied to create and sustain success in organizations (Pande, 2007).

Transactional

This is based on the setting of clear objectives and goals for followers, as well as the use of either punishments or rewards in order to encourage compliance with these goals (Burns, 1978). Bass' (1985) model of leadership conceptualized transactional leadership as consisting of three dimensions: contingent reward and two forms of management by exception (MBE), active and passive. Goodwin et al. (2001) found that contingent reward is made of two factors: explicit psychological contract and implicit psychological contract. The latter is more closely associated with transformational leadership behaviours (Goodwin et al., 2001). A further analysis by Podsakoff, Bommer, Podsakoff and MacKenzie (2006) further distinguished between contingent reward, contingent punishment, non-contingent reward and non-contingent punishment.

Transcendent

Grounded in servant leadership, the transcendent style offers a pathway to increased trust necessary for global sustainability, offering a more inclusive and consensual decision-making process for the economic, social and environmental sectors, moving beyond a singular focus on the bottom line of profits to a multiple focus on the triple bottom lines of profits, people and planet. (Gardiner, 2006). Crossan, Vera and Nanjad (2008) defined transcendent

leadership as a form of strategic leadership that spans the levels of self, others and organization; it captures the quality of going above and beyond the narrow definition of a leader.

Transformational

This style of leadership – in which the leader identifies necessary change – creates a vision to guide the change through inspiration, and executes the change with the commitment of the members of the group. Brass (1985) built on Burns' (1978) description of 'transforming leadership' and developed a model of transformational leadership that encompasses four dimensions:

1. *Charisma* represents 'the degree to which the leader behaves in admirable ways that cause followers to identify with the leader'.
2. *Inspirational motivation* is 'the degree to which the leader articulates a vision that is appealing and inspiring to followers'.
3. *Intellectual stimulation* is 'the degree to which the leader challenges assumptions, takes risks, and solicits followers' ideas'.
4. *Individualized consideration* is 'the degree to which the leader attends to each follower's needs, acts as a mentor or coach'.

(Judge & Piccolo, 2004, p. 755)

Visionary

The visionary style – also referred to as charismatic – means that leaders articulate where a group is going, but not how it will get there, setting people free to innovate, experiment and take calculated risks (Goleman et al., 2002). House (1977) and House & Podsakoff (1994)

argue that charismatic leaders exude passion and self-confidence, engage in self-sacrificial behaviour, promote a collective identity, model desirable behaviour, establish high expectations for followers and express confidence that followers can achieve them.

4.3 Overview of relationship between Leadership and Lean Six Sigma

Lean Six Sigma has been extremely successful in some organisations, where it is no longer only a cost reduction initiative but has also been embedded into the organisation's way of doing things: more well-known examples are probably Toyota for Lean (Liker, 2003) and GE for Six Sigma (Eckes, 2000). However, many other organisations struggle to turn Lean Six Sigma into a success because of different failure factors (Albliwi, Antony, Halim Lim, & van der Wiele, 2014), and the question is whether different styles and traits of leadership can have an impact on whether the deployment of Lean Six Sigma results in organisational success. As Deming said (1994), quality is determined by top management and cannot be delegated, and the quality of the output of a company cannot be better than the quality at the top (Hilton & Sohal, 2012; Suresh, Antony, Kumar, & Douglas, 2012). Existing theory suggests that in order to implement a quality improvement process successfully, an organisation needs to have transformational leaders at the top (Waldman, 1993) to create the culture and objectives which must be adopted by transactional leaders in the middle management ranks (Waldman et al., 1998).

Research shows an inextricable link between leadership and commitment (Aboelmaged, 2011; Martinez-Jurado & Moyano-Fuentes, 2012; Waldman et al., 1998) at the basis of the success of a quality improvement programme: unwavering commitment to quality programmes from top management is fundamental for embedding those into the organisation's culture, allowing it to overcome the initial scepticism of employees (Bhasin 2012a, 2012b; Juran, 1989).

Leadership has been recognised as a mechanism for embedding cultural values and norms into an organisation (Schein, 1983); at the same time, the idea of culture affecting the type of leadership in an organisation has been advanced (Bass, 1985), suggesting the existence of a reciprocal relationship between leadership and culture in organisations (Waldman, 1993). Overall, Lean Six Sigma deployment needs to proceed hand in hand with cultural change in order to avoid falling into the same traps into which TQM fell in previous generations of quality improvement programmes (Albliwi et al., 2014; Bushe, 1988).

Leadership and organisational culture look at conditions within the organisation, but Forker (1991) noted how societal-level differences exist in the way quality and continuous improvement are defined in the USA, Japan, and what was the USSR at the time his article was written: these societal-level differences have an impact on the organisational culture. Putting all this together, similarly to the TQM model introduced by Waldman (1993), we suggest the model displayed in Figure 3 for illustrating the links between leadership, culture, and Lean Six Sigma.

Figure 3 Model of Leadership, Culture and Lean Six Sigma, adapted from Waldman (1993)

This model illustrates the key relationships so far identified in the literature.

1. the reciprocal impact of leadership and culture within the organisation;
2. the societal-level factors outside the organisation that have an impact on the organisational culture;
3. how (1) and (2) above impact on the Lean Six Sigma behaviours of employees affected by both the leadership and the culture prevalent in the organisation;
4. all the above combine to generate the Lean Six Sigma outputs.

5 Key emerging themes

The review showed that effective leaders have distinctive traits, such as drive, leadership motivation, honesty and integrity, self-confidence, cognitive ability and knowledge of the business (Kirkpatrick & Locke, 1991) that makes them stand out of the crowd. Since 2000, several new leadership styles have also been proposed (Anderson & Sun, 2015): ideological leadership, pragmatic leadership, authentic leadership, ethical leadership, spiritual leadership, distributed leadership, and integrative public leadership. However, they haven't been yet properly defined, with large areas of overlap among themselves and with more traditional styles previously studied in the literature. Anderson and Sun (2015) issue a call to leadership researchers to collectively develop a new model of leadership that encompasses what is unique about these various new styles being proposed. Defining what leadership traits are more conducive to a successful Lean Six Sigma deployment is critical for organizations that are about to embark on such a journey, so they can ensure the right leaders are in place.

This systematic literature review also highlighted the need to extend research on leadership and Lean Six Sigma to different cultures: since Kull, Yan, Lio and Walker (2014) showed that several dimensions of national culture can influence the effectiveness of a Lean implementation, the impact of geo-cultural issues on Lean Six Sigma can be an interesting research stream, particularly as so far most of studies have focused on the US and/or the UK.

There are also opportunities for further research in healthcare. It has been an important area of study in the past few years, and many case studies have demonstrated how Lean Six Sigma can improve the quality of care for patients, but there is scope for a more generalizable approach to patient care.

Finally, a need for more research in the effect of social constructs has also been highlighted: the effects of working environment, employee well-being, unionized workforce and social sustainability on the types of leadership required for a successful Lean Six Sigma deployment would be an interesting research stream.

6 Conclusion and agenda for future research

Lean and Six Sigma have become the most popular business strategies for deploying continuous improvement in manufacturing, service and public service organisations (Albliwi et al., 2015). Continuous improvement is the main aim for any organization to help them to achieve quality and operational excellence and to enhance performance (Thomas, Barton, & Okafor, 2009; Assarlind, Gremyr, & Backman, 2012).

However, despite its success in some organizations, others are struggling to turn Lean Six Sigma into a success, citing a lack of leadership, changing business focus, internal resistance and availability of resources as the main impeding factors (Timans et al., 2012), with Snee (2010) pointing out how Lean Six Sigma is an effective leadership development tool: ‘leaders enable an organization to move from one paradigm to another; from one way of working to another way of working. Lean Six Sigma provides the concepts, methods and tools for changing processes’. Leadership expert Kotter (1996, 2008) emphasizes how the continuous improvement journey needs to begin with a sense of urgency and Snee (2010) identified leadership as a much needed requirement for successful Lean Six Sigma deployment and critical to sustaining improvement.

The focus of this research was to consolidate the existing knowledge on leadership and Lean Six Sigma, providing a starting point for researchers and practitioners seeking to implement Lean Six Sigma in organizations and offering suggestions for future research. Limitations

inherent to the research design were the lack of differentiation between Leadership style required from Senior/Executive management and Middle management in organizations, and lack of differentiation among industry sectors, such as manufacturing and services: it is possible that a different style of Leadership may be required in different industry sectors and across organizations of very different size. However, it's clear that leadership is a critical factor for Lean Six Sigma success and its impact will be the subject of future research to determine what are the leadership traits more conducive to successful Lean Six Sigma. As we have seen, since 2000 several new leadership styles have also been proposed (Anderson & Sun, 2015), but they haven't been yet properly defined. There is a need to develop a new model of leadership that encompasses the leadership traits needed for Lean Six Sigma. This will also have managerial implications, helping organizations that are about to embark on a Lean Six Sigma journey to ensure they have the right leadership in place.

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