



Road towards Lean Six Sigma in Service Industry: A Multi-Factor Integrated Framework

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Review

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A Multi-Factor Integrated Framework

Abstract

Purpose - This study adopted a multiple case-study approach, of three companies, in order to identify the factors affecting Lean Six Sigma (L6 σ) implementation in service industry.

Design/methodology/approach – Secondary data were collected through companies' documents, written procedures and quality assurance policies. Primary data were collected through a number of in-depth interviews with managers and quality experts.

Findings - The analysis of qualitative data gathered through in-depth interviews with managers in all three cases resulted in the emergence of variety of CSFs regarding L6 σ implementation in service industry. As it can be seen the great majority of the factors have been identified in all three cases. Moreover the analysis shows that there are two categories of factors emerged.

Originality/value – This study has four major contributions. Firstly, it provides an intergraded multifactor framework regarding the implementation of L6 σ in service industry. In particular, this study contributes with three more particular factors that influence the implementation of L6 σ in services, namely *top-management active involvement*, *HR support activities*, and *practices & systems*. Secondly, it focuses on the responses of managers, who play the critical role in the adoption of L6 σ . Thirdly,

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5 supports and expands current literature on the key success factors of L6 σ application.
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7 Finally, it provides future ideas to explore and develop more the suggested L6 σ
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9 framework.
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14 **Key words:** *Lean Six Sigma, Critical Success Factors, Systems Approach, Multiple*
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16 *Case-studies, Service Industry*
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20 **Article Classification:** Research paper
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22 **Introduction**

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25 It has been argued that traditional management tools cannot cope effectively with
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27 current business complexities (Itkin, 2008; Chee, 2008). Therefore, a lot of companies
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29 continuously attempt to develop and implement new management ideas (Saravanan,
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31 2006; Chang, 2006). A question that emerges is what are the special conditions that
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33 affect the adoption of such practices in different than manufacturing organisations and
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35 industries. A prime example of such practices is *Lean Six Sigma* (L6 σ) which is a
36
37 synthesis of Six Sigma (6 σ) and Lean Management (LM). L6 σ targets to maximize
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39 shareholder value by achieving fast improvements in customer satisfaction, quality cost,
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41 and speed of the process (Sunhilde & Simona, 2007; Hill et al. 2011).
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46 By implementing this methodology, companies could improve business
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48 environment and therefore performance. It is an approach that is focused on quality and
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50 continuous improvement, based on the participation of all employees (Lubowe & Blitz,
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52 2008). L6 σ has been applied in manufacturing industry and in some cases in services
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54 and get good results, increasing efficiency of procedures and improving product quality
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56 (Bowen & Youngdahl, 1998; Engelund et al. 2009).
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5 L6 σ can be considered as another evolution of management tools in order to
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7 face increased competition and market shifts (Caldwell, 2006a). However, the main
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9 challenge for L6 σ are the special factors that influence its application in companies.
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11 These factors seem to be related to both success and failure of quality management
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13 systems (Moosa & Sajid, 2010). In other words, it has been widely argued that the
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15 application of operations management techniques is not only based on technical factors,
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17 but it is mainly associated with organisational-oriented factors like culture, climate,
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19 working environment, policies and procedures (Hope & Mühlemman, 2001; Noronha,
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21 2003; Ayoob, et al. 2003; Psychogios & Wilkinson, 2007).
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26 Nevertheless, the emphasis on the exploration of the factors above seem to be
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28 neglected from the current literature. In other words, there is a need to investigate the
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30 factors that are critical for the success or failure of such an initiative. These factors are
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32 known as critical success factors (CSFs) that are important in order to achieve effective
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34 levels of quality management (Saraph et al. 1989), organizational goals (Hardaker &
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36 Ward, 1987; Fishman, 1998; Hayes, 2000; Henderson & Evans, 2000), and
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38 organizational performance (Guimaraes et al. 1996; Dwyer et al. 2000).
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42 There are several studies that investigate CSFs of quality initiatives.
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44 Traditionally the most of these studies concern total quality management (TQM)
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46 programs (Yusof & Aspinwall, 1999), lean production (Achanga et al. 2006), and Six
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48 Sigma (Antony & Banuelas, 2002). There are also some studies referring to L6 σ
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50 (McManus, 2008; Ferguson, 2007; Lane 2008; Carreira, 2005; Arnheiter & Maleyeff,
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52 2005), but it seems that main emphasis is on manufacturing industry. The service
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54 industry, which traditionally is a more challenging organisational 'space', seems to be
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56 neglected for the application of such concept (Psychogios et al. 2012). In this respect the
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5 purpose of this paper is to explore and comprehend the CSFs related to the application
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7 of L6 σ .
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10 Moreover, since it is well documented that LM and 6 σ approaches are
11 complementary under a quality management philosophy tool (Antony et al. 2003;
12 Nāslud, 2008; Burgess, 2010; Vince, 2008; Shan et al. 2008) a more holistic approach
13 like this of systems science seems to be more capable of embedding philosophical and
14 cultural aspects of lean with the rigorous scientific approach of six sigma through a
15 unified hard / soft systems philosophy. In this respect, Pepper & Spedding (2010)
16 suggest that LM and 6 σ should be combined through the integrated management of
17 quality, a scientific approach and an ‘all-one-team’ approach “which optimises systems
18 as a whole and focuses on the right strategies in the correct places”. They conclude that
19 any such model should be: strategic and process focused; balanced between the two
20 philosophies to harness the recognised advantages of both; balanced between
21 complexity and sustainability; and structured around the type of problem experienced.
22 In similar vein, more recent scientific evidence revealed that while practitioner guides
23 prescribe brief implementation models they do not describe how they should be adapted
24 to particular organizational contexts (Orme et al. 2013). The existing approaches for
25 frameworking L6 σ methodology do not provide evidence towards soft systems thinking
26 (Orme et al. 2013). Therefore in this study is built on this argument, considering
27 systems approach as very useful one in understanding a complex process such as L6 σ .
28 In this respect, we argue that the factors influencing the application of L6 σ in service
29 industry cannot be seen and understood isolated to each other, but as a whole under the
30 formulation of a multifactor framework.
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56 The article is structured in six sections. The first section briefly introduces the
57 concept of L6 σ . The second section reviews the current literature related to L6 σ
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5 application while the third one presents study's research rationale. The fourth section
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7 explains the research methodology applied while the fifth one analyses the main
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9 findings. Finally, the paper is completed with a concluding section.
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11 12 13 **Lean Six Sigma**

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16 As a synthesis of 6σ and LM, $L6\sigma$ incorporates principles and concepts from both of
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18 them. 6σ suggests that there is a direct correlation between the defects appearing in
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20 products and customer satisfaction. 6σ based its success on the use of statistical methods
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22 for identifying defects and improving processes and at the same time responding to the
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24 voices of customers (Sharma & Chetiya, 2009; Fazzari & Levitt, 2008). Also 6σ is a
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26 methodology that improves business processes based on understanding, controlling
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28 variation and reduces cost of poor quality (Bendell, 2006; De Mast, 2006; Kanji, 2008;
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30 Harry, 1998; Chang-Tseh, 2007).
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34 In addition, LM provides a set of standard solutions to common problems and
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36 optimizes processes across the entire value chain, but lacks organizational structure,
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38 analytical tools and quality control (De Koning et al. 2008). The most challenging
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40 issues that organizations face are excess and waste of processes and their results. The
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42 waste constitutes mainly of resources, time, manpower and capital. In today's business
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44 environments companies need to reduce costs in order to offer cheaper and better
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46 quality services. The reduction in costs can be achieved if the organization attacks
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48 systematically on waste (Ferguson, 2007; Lane, 2008). According to LM rhetoric, the
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50 improvement in quality can be achieved by the limitation of every aspect that does not
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52 add value within the organization (Cooper, 2008).
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56 Although 6σ and LM have different backgrounds, they have similar goals.
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58 Nevertheless several of the businesses today have adopted one of the two approaches
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5 they found that competitiveness can be improved up to a point (Carreira, 2005). Beyond
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7 the positive results that can be achieved, Lean cannot bring a process under statistical
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9 control, while 6σ alone cannot dramatically improve the speed of the production process
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11 and reduce invested capital (Carreira, 2005). Therefore, a combination between the two
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13 methods is required (Arnheiter & Maleyeff, 2005). The combination may result on the
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15 reduction of process variation and elimination of waste (Furterer & Elshennawy, 2005;
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17 Jing, 2009; Antony et al. 2003). In this respect, $L6\sigma$ concept emerged as a balanced
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19 approach between the two concepts, attempting to create a synergy between their
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21 functionalities (Arnheiter & Maleyeff, 2005; Ferguson, 2007) and create extra value to
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23 organizations. $L6\sigma$ integrates 6σ and LM processes, where LM aims on cycle time and
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25 waste elimination while 6σ seeks to eliminate defects and reduce variation (Lubowe &
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27 Blitz, 2008).
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32 The implementation of $L6\sigma$ in a company should not be considered as the sum
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34 of many individual improvement projects, but complementing and simultaneous
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36 implementing approaches of LM and 6σ . $L6\sigma$ organization is the one where $L6\sigma$
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38 philosophy expanded in all business operations and units, establishes a culture and
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40 environment of creativity and innovation (Lubowe & Blitz, 2008). In this respect, it is
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42 critical to explore the special conditions that facilitate or/an inhibit $L6\sigma$ application.
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46 **$L6\sigma$ Implementation Factors**

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49 CSFs are those key aspects of activity that produce very satisfactory results critical for
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51 an organization to achieve its goals (Bullen & Rockart, 1981). CSFs can be considered
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53 as major starting points for the $L6\sigma$ implementation process. According to the literature,
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55 CSFs seem to be the key aspects of accomplishing companies' visions to improve
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5 customer satisfaction and delivery of quality outcomes. Thus, the purpose in this section
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7 is to discuss the CSFs that affect the L6 σ implementation.
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10 Exploring the literature we can distinguish several CSFs that influence L6 σ . In
11 particular, literature emphasizes on the integration of L6 σ with business strategy
12 (Lubowe & Blitz, 2008; Fornari & Maszle, 2004; Antony et al. 2007; Kamensky, 2008),
13 customer satisfaction (Antony et al. 2003; Antony et al. 2007; Andel, 2007; Lubowe &
14 Blitz, 2008), committed leadership (Laosirihongthong et al. 2006; Maleyeff, 2007;
15 Stuenkel & Faulkner, 2009; Carleysmith et al. 2009; Ladhar, 2007) and quality-driven
16 organizational culture (Furterer & Elshennawy, 2005; Maleyeff, 2007; Lubowe & Blitz,
17 2008; De Koning et al. 2006; De Koning et al. 2008; O'Rourke, 2005). At the same
18 time, L6 σ literature focuses on aspects like training (Anthony et al. 2003; Ladhar,
19 2007; Caldwell, 2006a; Antony et al. 2004; Delgado et al. 2010) and teamwork
20 (Neuhaus & Guarraia, 2007). Finally, it gives special attention to project management
21 issues (Antony et al. 2004; Laosirihongthong et al. 2006; Ladhar, 2007; Breyfogle,
22 2008), and the importance of technical systems (Kamensky, 2008). It is important
23 though to examine in more details the most important CSFs as indicated in many
24 studies.
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43 One of the most critical factors widely investigated is leadership. In the
44 methodology of 6 σ , leadership holds a decisive role for its success (Antony &
45 Fergusson, 2004; Laosirihongthong et al. 2006; Carleysmith et al 2009). Also, the
46 effectiveness of LM needs to be supported by strong leadership that binds workers to
47 form multifunctional and self-working groups, which can apply the tools and techniques
48 of eliminating waste (Al-Najem et al. 2012). The emergence of leaders' role is included
49 as key evidence in various early studies of L6 σ (Antony et al. 2003; Lubowe & Blitz,
50 2008) as well. Many authors (Shah et al. 2008; Marhevko, 2008; Byrne et al. 2007;
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5 Kumar et al. 2006; Johnson, 2006; Caldwell, 2006b; Furterer & Elshennawy, 2005;
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7 Thompsen, 2005) agree that L6 σ is a methodology that demands dynamic decisions,
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9 total participation of all employees, total confidence in the process towards the target
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11 and loyalty to the process. In this respect, active leadership is critical since it is the one
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13 that does not hesitate to take the subversive decisions and inspire the employees in order
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15 to be more efficient, consistent, committed, and satisfied, in order to meet the principles
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17 of L6 σ (Antony et al. 2003; Lubowe & Blitz, 2008). Byrne et al. (2007) argue that
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19 leaders must be driven by a vision based on market demands and in their own abilities.
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21 They also add the fact that leadership should aim to a constant innovation and to be
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23 committed to operational change that leads to success. According to other authors,
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25 leadership helps in changing the attitude of the personnel, empowerment readiness, and
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27 improvement of production processes and in business efficiency but also, focus on
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29 customers in order to achieve innovation and economic performance (Byrne et al. 2007,
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31 Thompsen 2005).

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36 Beyond leadership, organisational culture is another critical factor that impacts
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38 the application of L6 σ . It is perhaps the most difficult component needed to be changed
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40 in a company which wants to integrate successfully L6 σ (Tata & Prasad, 1998; Hope &
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42 Muhlemann, 2001; Noronha, 2003; Ayoob et al. 2003). This is the reason why various
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44 authors have emphasized that aspect for the application of quality management
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46 initiatives (Psychogios & Wilkinson, 2007). The cultural obstacle is mainly related to
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48 employee resistance who fear any change and future variations in their day-to-day
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54 L6 σ literature has recorded specific causes of L6 σ -oriented change failure. Three
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56 potential pitfalls may prevent proper culture change, the misinterpretation of
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58 standardization, the devaluation of the role of diversity and how to use the released
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5 capacity (Johnstone et al. 2011). For Johnstone et al. (2011), the failure of recognition
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7 of the importance of unwritten rules and tacit assumptions, which characterize their way
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9 of acting and performing, is one of the main factors for the failure of culture change that
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11 L6 σ requires. Byrne et al. (2007), suggest that specific cultures can inhibit L6 σ
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13 application due to the lack of the appropriate procedures, appropriate discipline and
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15 entrepreneurial philosophy, that encourages significant innovations on an ongoing basis.
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17 According to Hilton & Sohal (2012) the types of culture which have a positive effect on
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19 L6 σ are: group culture (participation, teamwork, facility leaders, people and
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21 obligations), development culture (creativity, flexibility, entrepreneurial leaders,
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23 innovation and new resources) and rational culture (efficiency, focus on target
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25 achievements leaders, orientation to the objectives and competition).
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30 Another vital factor for L6 σ initiative is innovation. Innovation is the use of
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32 knowledge in producing and delivering new products or services that consumers require
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34 (Hoerl & Gardner, 2010). However, a question raised from researchers is whether the
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36 L6 σ helps or restricts the innovation philosophy and *vice versa* (Johnstone et al. 2011;
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38 Polk, 2011; Carleysmith et al. 2009; Scheeres, 2009; Fowler, 2008; Lubowe & Blitz,
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40 2008; García-Porres et al. 2008; Byrne et al. 2007). L6 σ grows through formal
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42 procedures, roles and ways of thinking limits the freedom for creativity and
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44 consequently the possibility to express some form of innovation. At the same time, an
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46 innovation culture may be proved antithetical on the application of strict procedures and
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48 tools that L6 σ requires. However, there are research evidence supporting that L6 σ
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50 creates a beneficial environment in terms of creativity and innovation (Carleysmith et
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52 al. 2009; Johnstone et al. 2011; De Koning, 2008; Fowler, 2008). Other authors (Byrne
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54 et al. 2007; Lubowe & Blitz, 2008; García-Porres et al. 2008; Polk, 2011; Scheeres,
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56 2009), investigated and analysed the ways that L6 σ organisations can achieve
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5 innovation and excellent financial performance. Their findings suggest that L6σ
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7 organisations succeeded to have an integrated culture of innovation according to four
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9 attributes they developed: a) the innovative vision that is based on customer insights, b)
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11 a group of leaders who are committed to continuous innovation, c) the alignment across
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13 the entire range of business and d) organizational skills that have made innovation an
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15 everyday routine.
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19 In conclusion, there are both institutional and contextual factors. Also, these
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21 factors could be categorized into generic that applied in all types of organizations and
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23 sectors, as well as in organisational-specific (corporate culture, national mentality and
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25 working habits, particular PMS, quality system) and in industry-specific (services or
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27 manufacturing) (Psychogios et al. 2012). However, the major issue with the majority of
28
29 the above studies is that they mainly developed in manufacturing. However, L6σ
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31 methodology is not a standardized procedure so it can be used in various sectors and
32
33 various industries (Pande et al. 2000; Cross, 2007; Dreachslin, 2007). Nevertheless, it
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35 seems that service industry is still neglected from the research agenda of many scholars.
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37 This industry set a clear challenge for every quality initiative.
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41 **L6σ application in Service Industry**

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45 Recent literature shown that there is an increased interest is implementing L6σ in the
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47 service industry (Naslund, 2008; Byrne et al. 2007; Brett & Queen, 2005). However,
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49 there is a limited number of studies that attempt to identify the critical success factors
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51 that affect L6σ in services (Psychogios et al. 2012; Psychogios & Tsironis, 2012).
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54 For example, Vavra (2007) argues that L6σ can be successful in services when it
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56 lasts for a long time, which also depends on the level of its maturity. According to
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58 Hilton & Sohal (2012), a successful L6σ project in service organisations deploys in five
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5 stages, the launch, the early success, the scale replication, the institutionalization and the
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7 culture transformation. Another way of evaluating L6 σ success in services is related to
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9 four parameters, like total quality, process efficiency, responsiveness and cost (De
10
11 Koning et al. 2008, Shah et al. 2008). In similar vein, the successful implementation of
12
13 L6 σ in services depends on the level of competences and roles of the individuals that
14
15 run L6 σ project (i.e. black belts) (Mehta, 2007, Hilton & Sohal 2012).
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19 On the other hand, what seems to lack from service organisations is a systematic
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21 approach of business change and improvement (Naslund, 2008). These companies fail
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23 to properly implement L6 σ either due to the lack of appropriate leadership, or to the
24
25 incorrect selection of candidates for leadership positions that can take an inactive role
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27 and involvement (Brett & Queen, 2005). Moreover, successful implementation of L6 σ
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29 in services requires its integration with continuous improvement philosophy (Pojasek,
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31 2003), which means that a shallow confrontation with the project cannot result in its
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33 success (Malik & Blumenfeld, 2012).
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37 Gibbons (2006) emphasizes on improvement of the overall equipment
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39 effectiveness using L6 σ . Mazzola et al. (2007) focuses on the ways in which Lean and
40
41 6 σ can drive process improvement actions. Pojasek (2003) examines the initiatives that
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43 need to be taken for a successful L6 σ implementation. Pusporini et al. (2012) explain
44
45 how the use of L6 σ achieves maximum competitiveness of new service delivery. Vavra
46
47 (2007) & Naslund (2008) indicate that the proper implementation of L6 σ increases
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49 operational readiness for change. In similar vein, Leduc et al. (2010) involved the
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51 operational learning as a factor that can lead to business change and thus the
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53 achievement of objectives of L6 σ . Arumugam et al. (2012) pointed out that the
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55 observation function as a tool with a very important contribution to the success of L6 σ
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5 Kondić & Maglić (2008) argues that the most critical factor for the success of
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7 L6 σ in services is customer satisfaction. Manville et al. (2012) rank as the most
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9 important CSFs the enthusiasm, the support and commitment of senior management, the
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11 connection of L6 σ to business strategy, its connection with the client, understanding the
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13 techniques and tools, the selection and the priority programs, and finally, training and
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15 education. Timans et al. (2012) agree with the above criteria, but go further by adding
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17 the personal experience of the upper management team members with L6 σ projects, the
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19 development of leadership skills. They also emphasize some factors that prevent the
20
21 success such as the internal resistance, the unavailability of resources, changing
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23 business objectives and lack of leadership.
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28 An important conclusion from the above literature is that there is a generic
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30 agreement that the success of every L6 σ initiative depends on specific CSFs in service
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32 industry as it is depicted in figure 1. The great majority of scholars agree that there is a
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34 group of factors while others focuses on single ones. Also, CSFs of L6 σ application in
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36 service industry could be classified in facilitators or inhibitors. The former influence
37
38 positively the process while the latter are considered as barriers to L6 σ successful
39
40 implementation (Psychogios & Tsironis, 2012; Psychogios et al. 2012). Moreover, all of
41
42 the studies above recognize the importance of the CSFs in L6 σ and some conclude that
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44 these factors play a much more significant role in comparison to previous quality
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46 initiatives like TQM and JIT (Naslund, 2008).
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50 Insert here figure 1
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52 **Rationale of the study**

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55 Literature suggests that CSFs like leadership, strategic orientation, teamwork, technical
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57 approaches (metrics-systems), and training affect L6 σ application in the service
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5 industry. The previous list is complemented by the appropriate organizational culture
6 which emphasizes on quality improvement and customer satisfaction. However, the in-
7 depth exploration of the interrelationship of the CSFs seems to be neglected by the
8 literature. What is missing is a holistic framework which integrates and interrelates the
9 CSFs that can contribute to our understanding regarding the implementation of L6 σ .
10 Since the majority of the above factors have emerged mainly in studies conducted in
11 manufacturing industry, service industry seems to be a more complex and challenging
12 business field for L6 σ application. Therefore, it seems that L6 σ research needs to turn
13 their attention towards service organisations (De Koning et al. 2008; Su et al. 2006).
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25 At the same time, the entire lean program and six sigma can be organized and
26 implemented within the basic structure of the Systems Approach (Pojasek, 2003). The
27 Systems Approach offers an ideal way to coordinate lean and six sigma. Neither lean
28 nor six sigma has a simplified means for determining continuous improvement and
29 tracking it. They may track costs, but not performance. By contrast, the Systems
30 Approach, L6 σ can cope effectively and efficiently with current business demands.
31 (Itkin, 2008; Chee, 2008; Pojasek, 2003). According to (Clegg & Orme, 2012) L6 σ is a
32 holistic soft systems methodology (SSM), which is the most suitable approach for
33 improving human activity systems, rather than hard systems thinking which is more
34 suitable for mechanistic or physical systems. However a clear concise model has not yet
35 been produced (Pepper & Spedding, 2010). Thus, the current challenge is to produce a
36 unified model of lean management and six sigma improvement that is systematic,
37 systemic and holistic which can be used to optimize systems as a whole (Clegg & Orme,
38 2012). The risk of not applying systems approach to L6 σ improvement initiatives is that
39 different levels (or pitches) of thinking (e.g. philosophy, methodology and tools) and
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5 their potential overlap will go unrecognized; and thus their potential impact on
6 organizational performance will be reduced (Clegg & Orme, 2012).
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10 In this respect, the present study attempts to expand our understanding regarding
11 the factors influencing the application of L6 σ in services by adopting a system view. In
12 particular, by analyzing research evidence gathered in three distinctive companies that
13 applied L6 σ , attempts to argue in favor of a multi-factor framework that can be critical
14 in its application.
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20 21 **Research Methodology** 22

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24 This study followed a multiple case-study approach as the most appropriate considering
25 the exploratory nature of the study (Voss et al. 2002; Nonthaleerak & Hendry, 2008;
26 Christy & Wood, 1999; Goodman, 1999). Qualitative research is particularly well-
27 suited to service industry investigations (Gilmore & Carson, 1996; Psychogios &
28 Priporas, 2007) and useful in case-driven research approaches (Ellram et al. 2004). This
29 is even more important when the phenomenon and the context under investigation are
30 not easily separated (Yin, 2003a, 2003b). A multiple case-study approach can also
31 provide more in-depth evidence in understanding complex relationships related to
32 operations and supply chain management (Ellram, 1996), which are associated with the
33 concept of L6 σ . Furthermore, through this research approach someone can identify
34 links between theory and method (Dubois & Araujo, 2007). In addition, an empirically
35 valid theory can be supported mainly by multiple case-studies (Eisenhardt & Graebner,
36 2007) that can explore and explain better social phenomena that cannot be identified
37 easily through other methods (Eisenhardt, 1989a 1989b). In a similar vein, Flyvbjerg
38 (2006) argues that through a case study approach we can explore things that cannot
39 easily identified with other methods. Also, an in-depth multiple case-study approach can
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5 increase the ability of organisational actors to take better decisions and improve
6 performance (Rendtorff, 2015). Finally, through a multiple case-study approach
7 comparisons of events and data across cases can be developed (Voss et al. 2002;
8 Nonthaleerak & Hendry, 2008).
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14 Furthermore, the qualitative approach it is more suitable for capturing complex
15 relationships (Delgado et al. 2010), for exploring the impact of different factors on
16 quality management tools, like L6 σ (Psychogios & Priporas, 2007). Finally, managers
17 are more likely to participate in a qualitative process of investigation (Coldwell, 2007).
18 Therefore, since the aim of the study was to explore an integrated framework of CSFs
19 that potentially affect the adoption of L6s in services, a qualitative approach was more
20 appropriate.
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30 In particular, three companies operating in service industry have been identified
31 as critical cases where L6 σ has been applied. Company A (CA) operates in
32 telecommunication industry, Company B (CB) operates in airline industry and
33 Company C (CC) operates in Insurance industry. Primary data were collected by
34 conducting face-to-face in-depth interviews with managers that involved in the L6 σ
35 application process. The interview questionnaire was a semi-structured one with open-
36 ended questions. The semi-structured interview can provide explanations of why things
37 happened (Creswell, 2003). In addition, the open-ended questions allowed participants
38 to develop their own views (Denscombe, 2003) on issues related to inter-organisational
39 relationships and dependence between the L6 σ and other management practises used
40 by the companies. The interview guide employed covered a variety of different issues
41 such as key service performance aspects and how they are measured and dependencies
42 among operations and quality targets of the companies.
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5 A purposive sampling approach was used in order to select the interviewees
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7 (Patton, 1990). The sample within the cases was based on the position that respondents
8
9 held in the organization and their functional involvement in the implementation process.
10
11 Managers that involved in the L6 σ application process were selected from a variety of
12
13 business areas like administration, quality assurance, human resources, sales, marketing,
14
15 operations, and IT. Also, some of the managers interviewed were experts in 6 σ (Black
16
17 Belts and Green Belts). In total 47 interviews were conducted, 15 in Company A
18
19 (telecommunication) 18 in Company B (airline) and 14 in Company C (insurance).
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23 Interviews conducted in an open manner guaranteeing that the participants
24
25 would freely respond the issues under investigation. All interviews conducted in English
26
27 language as the all of the participants are using English as their day-to-day working
28
29 language. The interviews began with questions developed to collect information
30
31 regarding interviewees' involvement in the process of L6 σ , in order to ensure that the
32
33 participants shared a sufficient understanding of the process under investigation. The
34
35 interviews recorded after permission taken and they transcribed shortly after occurred
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37 attempting to increase reliability (Eisenhardt, 1989b).
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41 Company's documentation related to quality programs, such as procedures and
42
43 quality management policies were used as secondary data. The analysis of the
44
45 secondary data contributed to the design of the interview questionnaire. Also, secondary
46
47 information helped to triangulate data and to increase overall validity (Marshall &
48
49 Rossman, 1999).
50

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52 Within-case analysis was conducted manually, in parallel with data collection, to
53
54 understand the main types of L6 σ (inter)dependencies. Following the work of Miles &
55
56 Huberman (1994), the data were pulled together in a database and categorised in terms
57
58 of source type (interview transcripts and documents). The data was coded to facilitate
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5 analysis, in accordance with practice (Krippendorff, 1980; Dubois & Gadde, 2002).
6
7 Open coding procedures were used (Strauss & Corbin, 1990). Through this method
8
9 emphasis was given in the identification of key-words related to the scope of the study.
10
11 These key-words and their interrelations were subsequently adjusted considering also
12
13 themes emerging from the data as well as additional theoretical insights from the L6σ
14
15 theory. Open codes were successively grouped into higher level categories using an
16
17 axial coding approach (Strauss & Corbin, 1990). Furthermore, searching for cross-case
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19 patterns, the method followed was the construction of an array, in order to identify
20
21 similarities and differences per category case (Voss et al. 2002). Finally, key findings
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23 were identified by using a pattern matching approach (Yin, 2003b) and then discussed
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25 with reference to the existing L6σ literature.
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33 Findings

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36 The analysis of qualitative data gathered through in-depth interviews with managers in
37
38 all three cases resulted in the emergence of variety of CSFs regarding L6σ
39
40 implementation in service industry (Voss et al, 2002; Meredith, 1998). In particular, the
41
42 multiple case-studies deployed allowed comparison of events that provided more
43
44 generic conclusions (Nonhaleerak and Hendry, 2008). This approach also contributed
45
46 in the exploration of the impact of different contextual factors on operations
47
48 management tools and techniques (Delgado et al, 2010; Psychogios and Priporas, 2007;
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50 Mangen, 1999). In addition, taking into consideration the nature of services, the analysis
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52 of the qualitative data provided more robust results regarding the application of L6σ
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54 (Gilmore and Carson, 1996).
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5 Table 1 depicts in more detail the sources of the CSFs according to the case each
6
7 one emerged after the interviews with managers. As it can be seen the great majority of
8
9 the factors have been identified in all three cases. Moreover the analysis shows that
10
11 there are two categories of factors emerged.
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14 Insert here table 1
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17 It is important though to see in more details how these factors are supported with
18
19 evidence provided by the three cases investigated. *Top management involvement &*
20
21 *support* was identified as a factor that facilitates the process. This finding, presenting in
22
23 table 2, seems to be in line with findings from previous studies (Lubowe & Blitz, 2008;
24
25 Antony et al. 2003; Carleysmith et al. 2009).
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29 Insert here table 2
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31
32 Similarly, strong and committed leadership seems to be critical for L6 σ
33
34 implementation in service industry (see table 3). The leadership aspect can widely be
35
36 observed in all of interviewees' responses. Indicative of a committed leadership is the
37
38 fact that the majority of functions are coordinated by top executive officers in all cases
39
40 explored.
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44 Insert here table 3
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47 In addition, *Quality-driven organizational culture* (see table 4) seems to
48
49 facilitate the process of overcoming barriers for successful implementation, which is
50
51 aligned with the suggestion that quality management systems demand organizational
52
53 culture change (Furterer & Elshennawy, 2005; Maleyeff, 2007).
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56 Insert here table 4
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5 *Continues training* is also critical for L6 σ application, and especially this
6 training related to project management tools and development of soft skills (see table 5).
7
8 Previous studies seem to support similar arguments (Antony et al. 2003; Caldwell,
9 2006a; Ladhar, 2007).
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14 Insert here table 5
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17
18 Moreover, the emphasis on *teamwork in problem solving* (see table 6) and
19 collective decision-making process, seems to be substantial in L6 σ , at least for the two
20 out of the three cases explored. This again supports similar findings by Neuhaus &
21 Guarraia (2007).
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27 Insert here table 6
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30 *Direct link between L6 σ and customer satisfaction* (see table 7) is considered to
31 be the guiding principle for implementation of L6 σ . This is in line with literature
32 (Antony et al. 2003; Antony et al. 2007; Lubowe & Blitz; 2008). L6 σ projects need to
33 start with transfer of the Voice of the Customer (VoC) to the Voice of Processes (VoP)
34 and of course the synthesis between the VoC and the Voice of the Business (VoB)
35 (Psychogios, et al. 2012).
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44 Insert here table 7
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47 In addition, *strategic orientation of quality improvement initiatives* (see table 8)
48 has been proved as another important element of the successful application of L6 σ . The
49 interviewees' arguments show that a strong relation between the two facilitates the L6 σ
50 process, which seems to be also supported by the current literature (Lubowe & Blitz,
51 2008; Fornari & Maszle, 2004; Antony et al. 2007; Kamensky, 2008).
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59 Insert here table 8
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Moreover, *supportive Technical systems* like appropriate *tools, techniques* as well as *supportive IT systems* (see table 9), have been considered as extremely substantial in the proper application of L6 σ , at least for the two industries investigated, namely telecommunication and airline. This finding seems to support similar findings by Kamensky (2008), that argues in favor of an appropriate infrastructure with technical approaches that can facilitate L6 σ .

Insert here table 9

Finally, *clear targets for L6 σ projects* (see table 10) is confirmed in the two out of three cases as important aspect of L6 σ implementation, which is also confirmed by the existing literature (Antony et al. 2004; Laosirihongthong et al. 2006; Ladhar, 2007; Breyfogle, 2008).

Insert here table 10

Nevertheless, this study identified two other factors that seem to be equally significant in L6 σ implementation. The first is referred to *prior implementation of other quality management initiatives*, (see table 11) such as ISO, EQA, etc. This provides the necessary experience for the employees regarding quality management. Also the documentation of all the processes, required by prior systems, such as ISO, seem to facilitate L6 σ . Therefore, it seems that this experience provides the appropriate knowledge and expertise for L6 σ application. It is interesting to mention that most of the interviewees suggested that it would have been better first to deploy L6 σ in the organization and then ISO standards, because in that case ISO standards implementation would have been more formal. In other words, prior deployment of quality management practices seems to facilitate L6 σ implementation.

Insert here table 11

Similarly, almost all interviewees from the two out of the three companies agreed that *integration of L6 σ with the performance management system* (see table 12) can facilitate the implementation process of the former. This integration motivates managers and employees to increase the level of commitment and involvement. For instance, a group of interviewees pointed out that the integration is necessary in order to minimize subjective performance evaluation of individuals that leads to wrong results.

Insert here table 12

Several authors agreed that the management involvement and commitment are important aspects in the service industry for L6 σ and any other quality practices implementation (Abdullah et al., 2008; Worley & Doolen, 2006; Chakrabarty and Tan, 2007; Psychogios and Wilkinson, 2007; Cotte et al., 2008; Psychogios et al., 2009, Appiotti and Bertels, 2010; Psychogios, 2010).

In sum, it can be argued that the factors briefly examined above can be considered as major starting points for the L6 σ implementation process in service industry. According to the literature, as well as the arguments and findings of this study, these CSFs seem to be the key aspects of accomplishing service companies' visions to improve customer satisfaction and delivery of quality outcomes. In particular, these factors concentrate on both macro (overall organization change towards continuous improvement), and micro (particular service quality improvement and problem resolution on a project level) aspects of the implementation process (Psychogios, et. al., 2012).

Discussion and Conclusions

The present study addressed a series of CSFs for implementation of L6 σ in three service companies. Analysing current L6 σ literature and investigating the particular organizations, we can support the view that these factors can be seen as facilitators. Current research confirmed that the CSFs analysed in the previous section are not consist only a significant framework of L6 σ application, but also a good investigation tool in a potential application of such a system.

Moreover, an integrated framework can be emerged from the synthesis of these factors. Figure 2 presents the proposed L6 σ application framework for service organisations. This framework consists of three new components that are equally critical aspects that encompass the whole framework and concerns the totality of the L6 σ implementation is service organisation.

Insert here figure 2

The above multifactor framework needs three main aspects in order to be implemented successfully. In particular, every single continuous improvement paradigm requires strong leadership that is associated with commitment and support coming from the top of the organisation and applied accordingly to every single hierarchical level. Also, human resources (HR) support activities and practices & systems seem to be another two critical aspects. Every component consists of the CSFs revealed from the present study.

The *active involvement of top management* plays a significant role as a prerequisite for the implementation of L6 σ and can be considered as a major issue of the suggested framework. This involvement starts with the commitment of the management towards the need of applying such a concept for achieving competitive advantage. The

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5 commitment occurs when managers have realized that it is imperative that the operation
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7 of the business in an innovative way and that the chosen approach is one of the best
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9 options. The sense of imperativeness depends on the current position in terms of the
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11 customer requirements, stakeholder expectations, the strategic positioning, and the
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13 economic performance.
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16 It is also critical these factors to be framed by the additional *HR support*
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18 *activities*. Clear definition of roles and responsibilities is needed. The implementation
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20 of every improvement initiative requires the existence of a group that will lead the
21
22 effort. While all employees need to understand the vision of L6 σ and eventually to be
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24 able to apply some of the techniques of the process to improve their work, managers
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26 need lead this effort. The goal of the leading team is to support every effort and
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28 individual. They are responsible of the proper training of the team members and other
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30 workers and to empower the efficient collaboration among employees on specific
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32 abilities and skills of decision making processes. Additionally, teams will have to set
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34 clear goals, take responsibility, manage crises and to have effective partnerships with
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36 other groups. The L6 σ needs teamwork, with many capabilities for effective
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38 collaboration and problem solving (George et al. 2004).
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43 Furthermore, this aspect is related to the resources based view (RBV) of the
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45 organization. The role of the HR on the firm success has been documented as very
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47 important (Newbert, 2007). Employees, regardless of their position in the hierarchy,
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49 have certain skills. The reason that the right choice of the human resources is considered
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51 vital for the successful implementation of business change is the fact that policy and
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53 strategy of HRM is at the heart of organizational system. The management must realize
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55 that need to use all the experience and skills of employees, along with specialized tools
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57 and systems, aligning them with organizational vision, goals and business strategies
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5 (Pekka-Economou & Lykogianni, 2005). The task of management is to strengthen the
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7 core values and capabilities (core competences) of workers in order to achieve the
8
9 perfection of the organizational system (Dahlgaard & Dahlgaard-Park, 2006).
10
11 Employees, strategically placed in key positions, will contribute in this way greatly to
12
13 the successful transition to the new situation. Through cooperation and participation,
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15 while providing continuous education and training, respectfulness of their efforts and
16
17 ultimately empowering them to make decisions that will make their work easier, but
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19 also the objectives of management, provided all the guarantees for employee
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21 satisfaction (Pekka -Economou & Lykogianni, 2005). Satisfying this in turn leads
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23 employees to become a driving force for the company that is trying to change the
24
25 structures and to implement a new methodology.
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30 The third aspect concerns *practices and systems*. It is a set of supporting actions,
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32 tools and computerised systems. Practices and systems existence are essential for
33
34 assuring L6 σ promises. The correct selection and use of practices and systems is a vital
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36 factor of any successful L6 σ implementation plan. This factor includes simple and
37
38 complex tools that can cover all functions of the project. Before any implementation the
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40 availability of resources within the company, the usage and scope of each practice and
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42 systems and project's characteristics should be considered carefully.
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46 In a recent study a structural equation model (SEM) developed in order to
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48 support this framework with more robust quantitative evidence gathered from a large
49
50 number of companies (Tsironis, 2014). Although this study is an ongoing one, the
51
52 model showed the relationships among factors which their existence is necessary for the
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54 acceptance and survival of L6 σ initiatives. This framework can be seen as the
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56 managerial basis for visualizing in every organization the meaning of L6 σ as
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58 organizational change process.
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5 Beyond the above arguments, the main limitation of the study is the fact that in
6
7 all three cases only managers and top-administrators were approached. Frontline
8
9 employees who are also directly involved in L6 σ approach, may offer a more clear view
10
11 on issues related to the impact of critical factors on L6 σ application. Therefore, it is
12
13 critical for future studies to investigate first-line employees that always play an equally
14
15 substantial role in the application of integrated quality management initiatives like L6 σ
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17 (Psychogios et al. 2009).
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21 Moreover, it would be critical for future research to clarify the CSFs identified
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23 by this study. In other words, more combined methodologies need to be applied
24
25 targeting to widely explore the influence of the factors on L6 σ application as well as to
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27 investigate in depth the hidden agenda of its implementation. Also, further research
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29 should emphasise the exploration of the application of the above framework in other
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31 than service industry. Furthermore, it is critical to understand that beyond the generic
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33 factors, there are specific ones applied in specific contexts that need to be taken into
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35 account. Finally, a critical point for a future research would be the quantification of each
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37 one of the three components suggested. This would enhance a wider survey that could
38
39 provide rich evidence towards the support of such a model.
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43 Beyond the above suggestions we can strongly argue that this study has four
44
45 major advantages. Firstly, it expands our understanding regarding the implementation of
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47 L6 σ in three different service industries, in which the application of management
48
49 models is more complex and problematic. Secondly, it focuses on the responses of
50
51 managers, who always play the most significant role in the adoption of such techniques.
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53 Thirdly, supports current literature on the key factors of L6 σ application. Finally, it
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55 contributes to our understanding of L6 σ process in services, by proposing a multifactor
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57 framework.
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5 This framework of L6 σ application in service industry can be used in facilitating
6
7 two main issues: first, it can facilitate managers of service industries to understand the
8
9 aspects of L6 σ method in their organisations. Second, it can guide managers in
10
11 recognising the key factors that potentially will influence the effective implementation
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13 and therefore the success of L6 σ in service organisations, where by default the
14
15 application of such practices is much more challenging in comparison to manufacturing.
16
17 Though the framework needs to be treated as a dynamic one rather than as a static and
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19 future research can contribute in recognising the nature of the dynamic factors in service
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21 industry.
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For Peer Review

Figure 1: CSFs influencing the Application of L6σ in Service Industry



Figure 2: Multifactor Model of L6σ Application in Service Industry



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Table 1: Key Success Factors of L6 σ across Cases

CSFs	Company A Telecommunicati on	Company B Airline	Company C Insuranc e
<i>Management involvement & support</i>	V	V	V
<i>Committed leadership</i>	V	V	V
<i>Quality-driven culture</i>	V	V	
<i>Quality-driven training</i>	V	V	V
<i>Teamwork</i>	V	V	
<i>Link L6σ targets and customer satisfaction</i>	V	V	V
<i>Binding strategy with L6σ targets</i>	V	V	V
<i>Supportive technical systems</i>	V	V	
<i>Clear targets of L6σ projects</i>	V	N/A	V
<i>Prior experience in implementing similar quality initiatives</i>	V	V	V
<i>Link performance management system with L6σ</i>	V	N/A	V

Table 2: Evidence towards top management involvement & support

CSFs	Indicative Statements	Source of evidence
<i>Top-Management involvement & support</i>	<i>"During the application of L6σ the great majority of top-mangers had active participation in all phases"</i>	Quality assurance manager - black belt (CA)
	<i>"Top management involvement was critical during the phase of adoption of the concept"</i>	Operations manager - black belt (CB)
	<i>"Managers did care about results and since they realised that L6σ can bring those they show great support"</i>	Sales manager (CA)
	<i>Top-management was determined towards the targets of the method from the first moment"</i>	Marketing manager (CC)

Table 3: Evidence towards Committed leadership

CSFs	Indicative Statements	Source of evidence
<i>Committed leadership</i>	<i>"Managers show commitment towards the application of the tool and this was a great motivation for everybody"</i>	Chief operations manager (CB)
	<i>"Leaders' commitment supported people moral during the first difficult phase"</i>	HR manager (CA)

Table 4: Evidence towards quality-driven culture

CSFs	Indicative Statements	Source of evidence
Quality-driven culture	<i>"The culture here drives recruitment and selection of the appropriate knowledgeable and experienced staff to support changes"</i>	Assistant quality assurance manager - green belt (CB)
	<i>"L6σ helped to change the culture and improve in terms of information flow and knowledge transfer"</i>	HR manager (CA)

Table 5: Evidence towards quality-driven training

CSFs	Indicative Statements	Source of evidence
Quality-driven training	<i>"Training is critical since can guide people to know who the customer is (internal and external)"</i>	Quality assurance manager - black belt (CA)
	<i>"It is critical to begin the project with training on tools techniques but also project management and process of change"</i>	Operations manager - black belt (CC)

Table 6: Evidence towards teamwork

CSFs	Indicative Statements	Source of evidence
Teamwork	<i>"Both regular and spontaneous meetings among people participated in L6σ application proved very important in binding the team together"</i>	Logistics officer (CB)
	<i>"Managers gave great consideration to teamwork as a critical aspect to deal with incidents"</i>	Chief operations officer (CB)

Table 7: Evidence towards link L6 σ targets and customer satisfaction

CSFs	Indicative Statements	Source of evidence
Link L6 σ targets and customer satisfaction	<i>"It was widely understood from the beginning that L6σ is applied in order to improve quality and therefore, deliver what customers want"</i>	Assistant quality assurance manager - green belt (CB)
	<i>"According to the vision of L6σ the customer is the decision maker"</i>	Logistics officer (CB)
	<i>"Customer demand triggers the whole organization L6σ helped to make this clear to the whole personnel"</i>	Marketing manager (CC)

Table 8: Evidence towards binding strategy with L6 σ targets

CSFs	Indicative Statements	Source of evidence
Binding strategy with L6 σ targets	<i>"L6σ was linked to strategic goals for the coming years and their implementation".</i>	Operations officer (CA)
	<i>"The major strategic objective is to reduce cost and satisfy the customer. This was related to what L6σ attempted to do"</i>	Chief operations officer (CB)

Table 9: Evidence towards supportive technical systems

CSFs	Indicative Statements	Source of evidence
Supportive technical systems	<i>"L6σ requires specific integrated systems for performance, service quality and process management. Plus total involvement of employees"</i>	IT manager - black belt (CC)
	<i>"Appropriate systems facilitates and motivates employees to adjust their attitudes towards L6σ philosophy"</i>	HR manager (CC)

Table 10: Evidence towards clear targets of L6σ projects

CSFs	Indicative Statements	Source of evidence
Clear targets of L6σ projects	<i>"Project targets need to be selected around specific standards like financially measurable results, high proof of improvement, etc".</i>	HR manager (CB)
	<i>"The responsibility of defining the selection criteria belongs to the company and its people"</i>	IT manager (CA)

Table 11: Evidence towards prior experience in implementing similar quality initiatives

CSFs	Indicative Statements	Source of evidence
Prior experience in implementing similar quality initiatives	<i>"The application of systems like ISO9002 and similar, enhanced employees to understand what they need to do under the L6σ context"</i>	Operations manager - black belt (CC)
	<i>"TQM projects prepared people for similar changes."</i>	Assistant quality assurance manager - green belt (CB)

Table 12: Evidence towards link performance management system with L6σ

CSFs	Indicative Statements	Source of evidence
Link performance management system with L6σ	<i>"One critical issue was that we have clearly linked L6σ to the established performance management system. This helped employees to understand better their individual targets"</i>	HR manager (CC)
	<i>"The combination of the new tool with the performance appraisal system proved to be critical for employees' acceptance and understanding of the new quality oriented targets."</i>	HR development manager (CA)