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This work aims at analyzing if the perception of success and barriers of lean projects varies with the managers working position, measuring the perception's bias of the success and barriers of company managers. The research questions answered by this work are the following ones: is the perception of lean projects' success and lean practices implementation level biased by the position recovered by the respondent? Do respondents present a different perception of barriers experienced during lean project deployment, depending on their working position? A survey was carried out collecting information from top, middle and non-managers from 171 firms from 23 countries. Data were analysed through a Multiple Analysis of Variance in order to discover differences and similarities in lean projects' evaluation among various categories of managers and employees. Moreover, as existing literature highlighted that difficulties vary with the project progress, the Multiple Analysis of Variance was separately conducted for the start-up and the sustaining phase of the projects. Useful managerial advice can be extracted from the results since they evidence the existence of significantly different perceptions: the higher is the managerial position, the lower is the direct involvement in lean projects and the perception of success and barriers, and vice versa.

Keywords: lean projects; lean barriers; perception bias; strategic barriers; economic barriers; supply chain integration barriers; human barriers; cultural barriers; attribution theory; MANOVA

1. Introduction

Sometimes the results obtained by lean projects, i.e. the implementation of lean practices with the aim of improving companies' performances or reducing wastes (DeSanctis, Ordieres Mere, Bevilacqua, & Ciarapica, 2018), are not always as performant as expected. For instance, several studies accomplished in UK organisations revealed that less than 10% of projects achieved a successful lean implementation (Bhasin, 2012b). Some authors (Hines, Holweg, & Rich, 2004) highlighted that the main reason for these poor performances could be found in a fundamental aspect overlooked by the majority of the organisations undertaking a Lean journey: the need to introduce the organisational culture and mindset. Several authors identified barriers to lean deployment. Recently, Albliwi, Antony, Abdul, Lim, and van der Wiele (2014) analysed 34 common failure factors for Lean Six Sigma implementation. Bhasin (2012b) classified 15 categories of lean difficulties in UK companies, and Jadhav, Mantha, and Rane (2015) identified 24 groups of barriers.

Despite previous studies identified a vast number of failures in lean projects and proposed a set of critical factors, there is a lack of analysis in the success perception within

the various participants in lean projects. In this work, we consider the perception of the achievement of projects' objectives as a measure of project success; however, since we are dealing with perception, this is not a univocal measure. Moreover, the perception of success solves a problem of data availability at all hierarchical levels (Baranowska-Prokop & Sikora, 2014) since it can be directly asked the interviewees. Another critical aspect is characterised by the attitude to attribute success and failure on individual or collective basis since it impacts the perception of the final project assessment of the whole organisation. This theme is of particular interest in lean context since lean philosophy is mainly focused on human resource management and human-related practices (Bortolotti, Boscari, & Danese, 2015): hence, if people are the core of lean philosophy, they also have the primary responsibility for the successful or unsuccessful implementation of such projects.

Moreover, people working in influential positions are responsible for the development of the ability of implementing and sustaining lean in the factory area (Lodgaard, Ingvaldsen, Gamme, & Aschehoug, 2016), impacting the behaviour of employees at all levels: a great attention should be focused on collaboration among teams, projects, and departments (Burström & Wilson, 2015). According to Walsham (1993), in the evaluation process within multi-level social contexts, personal assessments carried out by project stakeholders impact the results of the evaluation. Thus, the participants to a project should be able to evaluate their contribution fairly, not aiming to reach personal (Knights, 1995). According to Bartunek (1981), managers who incorrectly analyze employees' behaviours can mine the effectiveness of the organisations: misunderstandings and incomprehension can cause breakdowns in communication and cooperation, leading companies to poor performance or failure. Hence, it is essential to make managers aware of factors affecting how they judge themselves and others. Post, DiTomaso, Farris, and Cordero (2009) analysed the differences perceived by Indian, Chinese, and Caucasian scientists in determining their managerial attitudes, while Martínez-León, Olmedo-Cifuentes, and Ramón-Llorens (2018) studied the perception of success and satisfaction regarding engineers' carriers. Other authors such as Gok, Deshpande, Deshpande, and Hunter (2012) evidenced the existence of three main perceptual biases during the attribution process: fundamental attribution error – that is the attitude to underestimate situational influences on human behaviour, giving more weight to internal dynamics (Gawronski, 2004); self-serving bias, which consists of claiming responsibility for success while attributing failure to situational dynamics (Virine & Trumper, 2009); actor-observer bias: actors tend to attribute their behaviour to environmental conditions, while observers emphasise the role of dispositional determinants in evaluating actors actions (Jones & Nisbett, 1972).

Even if the correctness of the effectiveness of evaluation is studied in the literature, the bias introduced by subjective perceptions is rarely considered in the operations field, and it has never been associated with barriers to the implementation of lean projects. Due to the increasing number of companies applying lean, the importance of evaluating objectively a lean project is taking an important role. Indeed Lean Projects involve multiple objectives, multiple risks and uncertainties and multiple stakeholders inside and outside the company. Cunha and Moura (2015) evidenced that the difficulty of making logical choices increases with the number of factors involved in the analysis. For this reason, project managers tend to approach projects basing on their perception: this could cause subjectivity in evaluating these projects.

Considering that a lean journey involves several factors and both hard and soft practices (Bortolotti et al., 2015), the already mentioned attitudes could be encountered during the implementation of a lean project. Moreover, the success in implementing some 'Lean

Soft Practices' might be difficult to evaluate through objective indicators. Hence the performance measurement system sometimes is based on company managers' opinions. In this context, we aim at investigating if company managers show a perception bias in lean projects and if this perception bias is related to managerial aspects. This attitude is related to the fact that individuals live in a social environment, they observe their behaviours and those of other people, making inference on what causes a phenomenon and adjusting their evaluation accordingly (Wilson & Keil, 2001). This work addresses this research gap trying to analyze the managerial and sociological aspects connected to the perception of success and barriers to lean projects as well as to investigate the managerial implications of this perception. Two main objective questions will be answered in this research:

- Is the perception of lean projects' success and lean practices implementation level biased by the position recovered by the respondent?
- Do respondents present a different perception of barriers experienced during lean projects deployment, depending on their working position?

Answering these questions will enable managers to have a broader knowledge of the interactions among people collaborating in a lean project and, possibly, to understand how their judgment might be biased. In this way, they could surely support the team in solving relational problems, improving the collaboration and, hence, performance. These aspects are of fundamental importance in the lean context because of the great focus on people.

In order to develop this study, the work has been organised as follows: after this brief introduction to the main themes treated in the paper, a literary review is reported in Section 2 in order to analyze the perception bias in project performance evaluation and to identify failure factors of lean projects. In section 3, the theoretical background is presented in order to support research hypothesis development. The following section 4 reports an explanation of the methodology followed to collect the data and to formulate the measurement model. Section 5 is dedicated to results presentation, while section 6 and 7 are respectively destined to discussion and conclusion.

2. Literature review

2.1. Perception bias in project performance evaluation

When making judgments, company managers rely on heuristics or general rules of thumb (Cunha & Moura, 2015). Leybourne (2007) analysed a set of theories having a relevant impact on the execution phase of a project and recognised the importance of perception bias of project performance among project managers. In particular, this author evidenced how process theories – including attribution theory – play a vital role in motivating employees.

Accordingly, indeed, many authors used attribution theory (Heider, 1958; Jones & Davis, 1965; Kelley, 1967; Ross, 1977; Hewstone, 1989; Weiner, 1986), that is a subfield of social psychology that studies the interpretation of the causes of human behaviour, to explain the perception's bias in project performance evaluation. Generally speaking, attribution theory is an extensive examination of the perceived causes that many people apply to facts or experiences regarding themselves or others. A fundamental principle is that people strive to make their world and attribution functions as much controllable as possible, gaining the perception of being able to control the environmental forces (Brehm, 1966;

Guilfoyle, 2000). This result is supported by the so-called self-serving (Weary, 1979) or ego-centric bias (Heider, 1958; Jones & Davis, 1965; Kelley, 1967). Depending on the context, habits, and cultural environment, people present different attribution styles: for example, some are more likely to consider themselves as responsible for the success, and, meanwhile, exonerate themselves from failure responsibility. The cultural environment typical of specific organisations may influence the attribution trend, as already shown by several authors: as an example, we can cite Gok et al. (2012), who developed a study to compare the perception of various individuals who worked for the same organisation regarding causes of company's bankruptcy. The results evidenced different causal attributions, depending on the role recovered in the organisation. Standing, Guilfoyle, Lin, and Love (2006) analysed how project managers attribute Information Technology (IT) project success and failure; their results highlighted significant differences among support workers and IT executive managers' attributions attitudes: the former group tended to attribute the success to themselves, but not the failure. The latter group, instead, used to take responsibility for the failure while attributed the success to external factors. In healthcare projects, Palmieri and Peterson (2009) argued that cooperation between managers and clinicians is desirable in order to dismantle the punitive healthcare culture: in this way, the climate of fear in which clinicians operate will be mitigated, and system solutions for critical failures might be introduced.

Harvey, Martinko, and Gardner (2006) argued that organisational context is relevant to shape authentic leaders able to prevent inaccurate attributions in order to improve performances. Indeed, unbiased attributions contribute to build up trust and to create a collaborative environment. Some studies evidenced the interest of attribution theory even in behavioural sciences and economics. For instance, Martinko and Gardner (1987) presented a model analyzing employees' and leaders' attributions: through a literary review, they highlighted that different perceptions within these categories cause conflicts and incline relations.

As we can deduct from the literary review, perception bias of project performance is not widely considered in the operations field. Furthermore, a study involving this phenomenon and lean projects deployment has not been developed. Research combining attribution theory and lean barriers, together with lean success and lean implementation level could lead to a deep understanding of behavioural dynamics during projects deployment. Moreover, we are interested in extracting managerial implications, in order to enhance lean company's performances and to reduce the degree of difficulties experienced. In this context, next sections are dedicated to the identification and classification of lean barriers.

2.2. Barriers in lean projects

As previously stated, lean projects frequently fail or do not achieve the expected results. For these reasons, it is important to understand which are the factors preventing the achievement of such results in order to identify and correct them. Creating a classification of the barriers to lean projects deployment can support managers in noticing these criticalities and correct them to avoid projects' failure. Several authors identified and analysed failure factors or difficulties during lean projects. In order to collect the most relevant theoretical contributions in this field, a systematic approach was followed, searching in Scopus scientific database; some keywords (e.g. 'Lean practices', 'Lean barriers', 'Lean Manufacturing', 'Lean Management') were defined and those articles containing at least one of them and 'barriers' or 'failure' in the abstract or title were considered: 328 papers satisfied these requirements. Their abstracts were analysed to assess their consistency with the aim of the study; finally, 60 papers were considered in this literature review.

Among the selected works, we can cite Albliwi, Antony, Abdul, and Lim (2015), through a systematic literature review, created a list of 34 critical failure factors for Lean Six Sigma, putting a particular focus on the need of management support and on the availability of financial, technical and human resources. Bhasin (2012b) identified 14 lean difficulties bundles analyzing existing literature and, based on a study on UK organisations, listed 11 prominent obstacles. In the same research study, Bhasin (2012b) used a performance measurement tool to determine the impact of Lean Management on each of the interviewed organisations. In addition, Jadhav et al. (2015) identified 14 different difficulties in implementing Just in Time production system. In Antomarioni, Ciarapica, Sanctis, and Ordieres-Meré (2019), instead, five bundles of barriers are considered in order to identify whether the difficulties experienced during a lean journey were biased by the cultural environment, related to the geographical area.

Table 1 resumes a literary review on critical failure factors, highlighting common aspects identified by different authors. Lack of top management attitude, support, commitment and involvement, lack of training and education, Resistance of culture change/organisational culture, Poor communication, knowledge, and results sharing are the main problems identified by the majority of the authors. More recently authors are pointing more attention to strategic and economic aspects. An interesting aspect is constituted by those barriers identified only in recent papers (since 2009): poor organisation capabilities, high implementation costs, poor selection of candidates for belts training, lack of clear vision and a plan, and lack of effective model or roadmap to guide the implementation.

Moreover, some of the authors (e.g. Achanga et al., 2006; Jadhav et al., 2015; Halling & Wijk, 2013; Bevilacqua et al., 2017; Bhasin, 2012a; Hussain et al., 2014; Salonitis & Tsinopoulos, 2016) presented a classifications of the critical failure factors identified. As we can observe in Table 1, this classification is not univocal, and, also, aspects like Supply Chain Management have not been considered. For this reason, we added a further category, called Supply Chain Integration, to overcome this gap in the current literature.

An additional issue highlighted in the existing literature is related to culture – and human-related critical factors: the authors tended to consider those aspects conjointly, but, from the perspective of developing a questionnaire and as suggested by experts appositely interviewed, we decided to separate them. Further modifications were made in order to make the items of the questionnaire suitable for being submitted to and above all understood by company members of all ranks.

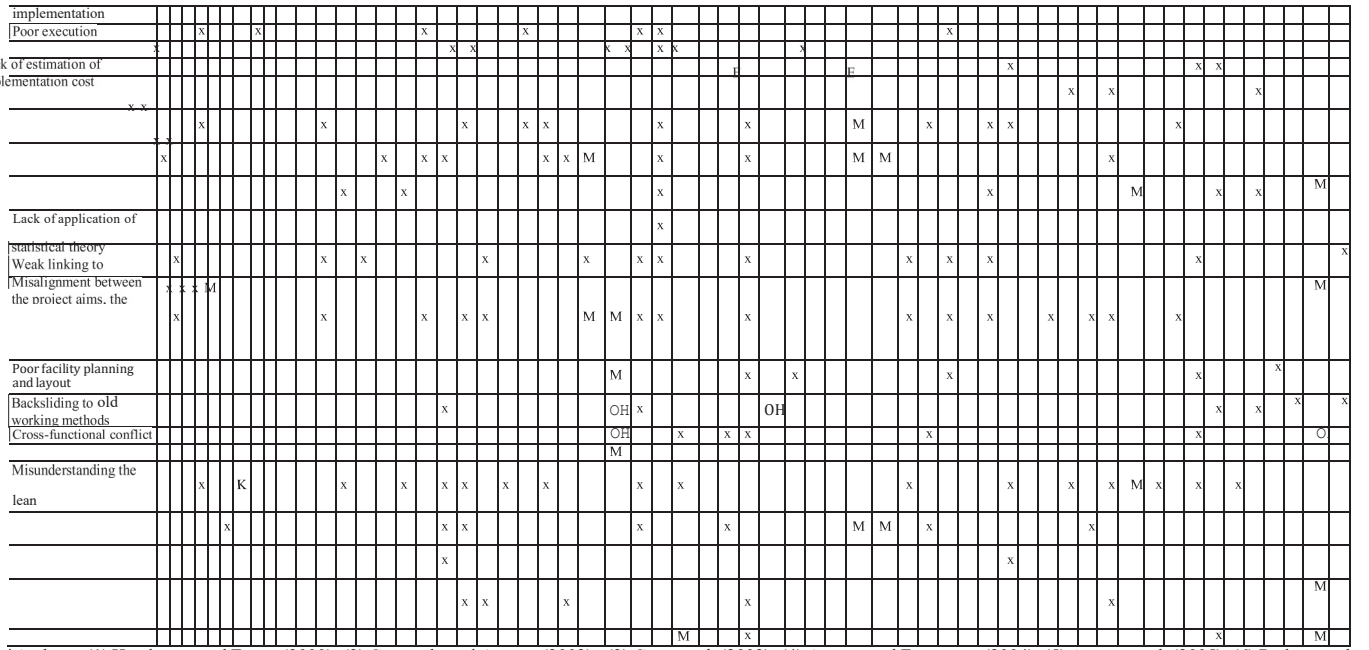
Integrating findings and considerations reported above, a generalisation was made and five main categories were chosen to group lean barriers: Strategic, Cultural, Economic, Supply Chain Integration and Human barriers. In particular, we identified as strategic all barriers that refer to the framework within which organisational decisions are made: managerial decisions that influence the nature and direction of the organisation. Strategic activities direct individuals within organisations as they make plans, marshal resources, and make day-to-day decisions. Cultural barriers refer to the patterns of activities and interactions that members observe and carry out (e.g. decision making, communicating). They constitute significant elements of the system's structure, making the structure itself an important culture-bearing mechanism in organisations (Uttal, 1983). We classified as Economic those barriers connected to the lack of human resources and capital in lean projects. Supply chain barriers refer to the level of involvement of customers and suppliers (Ciarapica, Bevilacqua, & Mazzuto, 2016) in lean projects, while Human barriers refer to managers' support and cooperation between company personnel during the lean projects. Even though these categories can be considered valid all along the lean journey, barriers can vary during the different phases of the lean project. For this reason, barriers in the

Table 1. Critical failure factors to implementation of lean practices in existing literature.

	Authors																													
Critical Failure Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Lack of top management attitude, support, commitment and involvement	x	x	x	x	x	x	M		x	x	x	x	x	x	x		x		x		x		x	x	M	M	x	x	OH	x
Lack of training and education	x	x		x					x			x		x	x		x		x	x	x	x	x	x	OH	OH	x	x	x	x
Poor project selection and prioritization		x		x								x												x				x	x	
Lack of resources (financial, technical, human, etc.)					x	x	E				x								x		x	x	x	x	E	E		x		x
Weak link between the continuous improvement projects and the strategic objectives of the organization		x	x	x	x												x	x	x	x					M		x	x	x	
Resistance to culture change/organizational culture		x	x	x		x	O	x	x		x	x		x			x	x	x	x	x		x	x	OH	OH		x		x
Poor communication, knowledge, and results sharing		x				x		x	x			x			x	x	x		x	x			x	x	x	x		x	K	x
Lack of leadership skills and visionary and supportive leadership				x			O		x	x						x	x				x		x		OH	OH	x	x	M	
Lack of consideration of the human factors	x	x															x											x	x	
Lack of awareness of the benefits and need of Lean/Six Sigma				x			M				x		x			x		x	x		x	x					x	x		
Wrong selection of Lean/Six Sigma tools		x		x			T	x																			x	X	T	
Lack of understanding of the different types of customers/VOC		x		x	x							x		x		x	x								x	x		x		
Lack of employee engagement and participation/lack of team autonomy						x			x		x	x	x	x			x	x	x	x	x			x	OH	OH		x	OH	
Lack of process thinking and process ownership						x											x				x							x		
Poor organization capabilities							M											x	x		x	x						x		
High implementation cost							E												x		x							x		x
Lack of experience in Lean/Six Sigma project implementation																		x			x	x					x	x		
Ineffective project management		x		x								x											x					x		
Poor selection of candidates for belts training						x				x								x	x		x			x			x	x		
Lack of clear vision and a future plan							M				x	x	x										x		M	M	x	x		
Lack of effective model or roadmap to guide the							M																	x	M	M	x	x		x

Critical Failure Factors	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Lack of top management attitude, support, commitment and involvement	x	x	M			x		OH	x	x	x	x	x	x	x	x	x	x		M	x	x	x		x			x	OH	x
Lack of training and education	x				x				x	x	x	x	x	x		x	x	x	x			x	x		x			x	OH	x
Poor project selection and prioritization						x					x		x				x												M	
Lack of resources (financial, technical, human, etc.)	x	x	E					E		x	x			x	x		x		x				x	x			x	x	E	x
Weak link between the continuous improvement projects and the strategic objectives of the organization	x	x		x			M	M					x	x		x		x									x		M	
Resistance to culture change/organizational culture	x	x	OH	x		x	OH		x	x	x	x	x	x	x	x	x	x	x	OH	x	x	x	x	x	x	x	x	OH	x
Poor communication, knowledge, and results sharing	x	x	M				OH			x	x			x				x		OH		x		x	x		x		OH	x
Lack of leadership skills and visionary and supportive leadership		x	M					OH						x		x		x					x						M	
Lack of consideration of the human factors																													OH	
Lack of awareness of the benefits and need of Lean/Six Sigma						x			x	x	x	x									x									x
Wrong selection of Lean/Six Sigma tools						x		T			x							x	x											
Lack of understanding of the different types of customers/VOC		x						OH				x	x			x			x											
Lack of employee engagement and participation/lack of team autonomy	x	x	OH		x			OH	x		x	x		x			x			OH		x	x						OH	
Lack of process thinking and process ownership				x																									M	
Poor organization capabilities		x										x		x																
High implementation cost			E				M	E				x							x	E			x			x				
Lack of experience in Lean/Six Sigma project implementation														x	x		x	x	x					x		x				
Ineffective project management													x																	
Poor selection of candidates for belts training							OH																							
Lack of clear vision and a future plan		x									x	x				x						x	x							
Lack of effective model or roadmap to guide the												x		x		x														

Table 1. Continued



*Authors: (1) Henderson and Evans (2000); (2) Coronado and Antony (2002); (3) Crute et al. (2003); (4) Antony and Fregusson (2004); (5) Antony et al. (2005); (6) Radnor et al. (2006); (7) Achanga at al. (2006); (8) Czabke et al. (2008); (9) Kumar et al. (2009); (10) Sim and Rogers (2009); (11)Mefford (2009); (12) Scherrer-Rathje et al. (2009); (13) Kovacheva (2010); (14) Yang & Yuyu (2010); (15) Grove et a1. (2010); (16) Suàrez-Barraza and Ramis-Pujol (2010); (17) de Souza and Pidd (2011); (18) Rahbek Gjerdrum Pedersen and Huniche (2011a); (19) Bakås et a1. (2011); (20) Bhasin (2012b); (21) Rahbek Gjerdrum Pedersen and Huniche (2011b); (22) Skrudupaite and Jucevicius (2011); (23) Zhang et a1. (2012); (24) Kundu and Manohar (2012); (25) Jadhav et a1. (2015); (26) Halling and Wijk (2014); (27) Albliwi et a1. (2015); (28) Lodgaard et a1. (2016); (29) Bevilacqua et al. (2017); (30) Aij et al. (2013); (31) Alinaitwe et al. (2009); (32) Ałmanei et al. (2017); (33) Bhasin et al. (2012a); (34) Boscari et al. (2016); (35) Chakrabarty & Chuan (2009); (36) Ğiamienê & Vienažindienë (2013); (37) Darabi et al (2012); (38) Hussain et al. (2014); (39) Jaiswal & Kumar (2016); (40) Khusaini ct al. (2016); (41) Kumar (2014); (42) Kumar & Kumar (20ł4); (43) Kwak & Anbari (2006); (44) Dos Reis Leite et al. (20ł6); (45) Moradlou & Perera (2017); (46) Mutingi et al. (2017); (47) Oladiran (2008); (48) Othman (2016); (49) Sahwan ct al. (2012); (50) Salonitis et al. (2016); (51) Sarhan & Fox (2013); (52) Shang & Sui Pheng (2014); (53) Singh & Singh (2016); (54) Vienazindiene & Ciamiene (2013); (55) Sharma et a1. (2014); (56) Yellinedi (2017); (57) Vieira et a1., (2018); (58) Sahoo and Yadav (2018); (59) Antomarioni et a1. (2019); (60) Yadav et a1., (2019).

**M = Management/Strategic; OH = Organizational culture and human factors; T = Lean Tools; K = Knowledge; E = Economic/Financial; X = Not classified

start-up phases of the lean journey and those of the sustaining phases will be treated separately (De Sanctis, Ordieres Meré, & Ciarapica, 2018).

According to this literature review, all aspects underlined in this section have been used in a questionnaire in order to quantify the level of barriers encountered by company managers during the implementation of lean practices (see questions C1.A1-C1.E6 in Table 11 and C2.A1-C2.E7 in Table 12 of the supplementary material).

3. Hypothesis development

Bhasin (2012a) analysed managers' and shop-floor personnel's perceptions of lean aspirations and performances, concerning both individual and collective perspectives. A substantial agreement was found in the understanding of lean objectives and individual career perspectives. Moreover, peers considered their attitude towards lean as fair but used to judge negatively other group's one. The authors recognised the presence of self-serving bias in these results. Furthermore Bidanda, Ariyawongrat, LaScola Needy, Norman, and Tharmmaphotnphilas (2005) submitted a survey to workers, academics and managers to analyze their opinion on the importance of different human issues recognised in cellular manufacturing: several differences were noticed, highlighting the need to integrate the different point of view in order to improve performances both in research field and in practical applications. Smith-Doerr, Manev, and Rizova (2004) analysed managers' perceptions of the success or failure of six technologically innovative projects. They highlighted that managers asymmetrically discuss success more than failure, and the type of centrality they have influences how they talk about success. Interpretive flexibility in the meaning of success occurs among more central managers who have access to more information through their network ties. van Dun and Wilderom (2016) evaluated the attitude of employees towards lean-team leaders in order to establish the existence of a relationship between typical leaders' behaviours and lean-team effectiveness. Their findings demonstrated that team leaders' values influence both lean-team effectiveness and team members' attitude: self-transcendence work values have a positive influence on team effectiveness, while conservative behaviour reveals a negative impact. Moreover, team members' attitude towards information sharing acts as a partial mediator between leaders' behaviour and lean-team effectiveness. Several studies analysed the impact of self-serving bias in relational contexts and situations, highlighting the attitude to claim responsibility for successes rather than failures (McCray, Purvis, & McCray, 2002). For instance, studies conducted by Sedikides, Campbell, Reeder, and Elliot (1998) suggest that the degree of self-serving bias observed depends on the kind of relation between group members: the closer the relation, the lesser the level of self-serving bias. Loewenstein (1996) argued that when individuals have to choose between what is best for themselves and what is morally correct, their definition of moral behaviour is biased by their interest. Moreover, according to Babcock and Loewenstein (1997), self-serving bias constitutes one of the leading causes of negotiation impasses. Indeed, they recognised the attitude of parties to consider what benefits themselves, hence a subjective perspective, as the fair view. If top management tends to attribute success both to external factors and to their capabilities, they also take substantive responsibility in case of failure. The measure selected to evaluate lean projects' success is perception: indeed, as noted by Baranowska-Prokop and Sikora (2014), this measure resolves the problem of data availability at all hierarchical levels.

From this analysis, it is evident that the managerial position of the respondent influences the perception of success in Project Management context. In light of these findings, we aim at analyzing whether this characteristic can be found also in lean projects. In particular, we

will consider the perception of lean projects' success (H1) and the perception of difficulties encountered during lean deployment (H2a and H2b) by company managers and non-managers. Moreover, the perception of lean implementation level (H3a and H3b), concerning Hard and Soft lean practices (Bortolotti et al., 2015). The following statement summarises the first hypothesis that will be tested in the following sections:

H1: Lean success' perception depends on the working position of the respondent.

An interesting contribution regarding the study of attribution in project critical failure factors is the one conducted by Gok et al. (2012). They compared attributions for corporate failure at three different organisational levels using an event analysis technique to collect top managers', middle managers', and non-managers' opinions on a project that caused their company's bankruptcy. Middle managers and non-managers were united in considering themselves as passive observers and recognising a deep impact of external and uncontrollable factors on their company's failure. On the other side, top managers considered themselves as active observers of their company's trend and attributed to their partners the blame for company's failure. A similar perspective could be applied to lean practices in order to test whether the role played in the company biases the perception of the level of barriers encountered. For instance, Lodgaard et al. (2016) conducted a case study, interviewing 28 managers and employees belonging to a unique company, to test top managers', middle managers' and workers' perception of lean barriers. An interesting aspect is characterised by the agreement between workers and managers according to the relevance of managerial barriers. In the early stage of lean implementation, instead, workers complain about managers' attitudes towards their proposal and suggestions.

Since the literature highlighted that lean barriers are different along the lean journey, a separate analysis will be conducted, differentiating between the lean journey start-up phase and lean journey sustaining phase. The former focuses on the initial efforts strengthened by the organisation in introducing the application of Lean Management; the latter considers the following feats to maintain the achieved results in the first step and to keep on improving performances. Although at the beginning of lean project development the level of interest is maximal, it is difficult to maintain this level for the whole life of the project. A drop of attention may occur: indeed, sustaining phase involves a long period and, as a consequence, a considerable amount of financial resources is required (Sabri & Shaikh, 2010).

H2a: The perception of barriers to lean implementation during the start-up phase depends on the managerial position of the company respondents.

H2b: The perception of barriers to lean implementation during the sustaining phase depends on the managerial position of the company respondents.

Some authors highlighted the existence of two types of lean practices: Hard and Soft lean practices (Bortolotti et al., 2015). The difference between these categories (Hard and Soft) can be found in their focus: while Hard practices concern the application of analytical tools (e.g. Statistical Process Control, SMED, Kanban), Soft lean practices refers to human aspects (e.g. training manager and employees, continuous improvement techniques, involvement of supplier and customer). It is proved that the application of Hard practices does not differentiate successful lean plants from unsuccessful ones, as, instead, the adoption of Soft practices does (Bortolotti et al., 2015). Indeed, Soft practices are crucial for achieving superior performance through Lean Management (Samson & Terziovski, 1999; Matsui, 2007) and sustaining the performance in the long term (Hines et al., 2004). A lack of attention in the application of Soft practices and extensive use of Hard ones reflect a misunderstanding of lean core principles. In this context, we decided to analyze if the lean implementation level considering these two bundles (hard and soft, respectively reported

in Tables 9 and 10 in the supplementary material) is related to the Lean success perception. The following statements summarise the hypotheses that will be tested in the following sections:

H3a: Lean success perception is connected to the Soft lean projects successfully developed by the company.

H3b: Lean success perception is connected to the Hard lean projects successfully developed by the company.

4. Methodology

In order to test the hypotheses proposed in the previous section, the methodology reported in Figure 1 has been adopted.

Next sections explain, in detail, every step shown in Figure 1.

4.1. Variables and survey design

The development of the questionnaire (see supplementary material) started from the literature review. Critical factors and barriers identified in section 2 were used to describe every company, under the hypothesis that specific questions were measurable and related to those categories. Such a hypothesis was later verified, including internal consistency. In order to make more explicit the compiling activity, the questionnaire was divided into four parts, organised into three sections. The first one regards company general information (section A). This first section of the questionnaire is used to contextualise the environment in which each company operates. The second section of the questionnaire concerns Lean Management practices (section B), the third one considers different barriers in the start-up phases (section C1) while the last one different barriers in the sustaining phases of lean programmes (section C2).

According to this schema, the first section (Section A) raises questions about the respondent position, firm company dimension (in terms of number of employees and sales), and industrial sector.

Section B is organised around the success of lean practices implementation, and it opens with an evaluation of the percentage of lean projects successfully developed by the company and continues with considerations about the implementation success of Hard and Soft lean practices.

Bortolotti et al. (2015) selection of Hard and Soft Lean practices have been used in the questionnaire apart from the substitution of Autonomous maintenance with Total Productive Maintenance, as it is a more general item.

Finally, the third section looks into the details about lean projects start-up and sustaining phases. Therefore, section C1 requires evaluating barriers faced during the start-up phase. A five-point Likert scale was used to assess the grade in which every item was experienced in the organisation. Items C1.A1-C1.E7 and C2.A1-C2.E8 show questions proposed (item description) in order to evaluate the level of Strategic, Economic, Supply Chain Integration, Human and Cultural barriers in start-up and sustaining phases. Questions regarding the

Figure 1. Methodology adopted.

sustaining phase are similar to those regarding start-up phase, but the focus is put on the problems connected to maintain lean thinking.

4.2. *Sample and data collection*

The interviewed managers belong to independent companies: indeed, the questionnaire was submitted to those firms operating in all industry fields of sector C, according to European Economic Classification ('Statistical Classification of Economic Activities in the European Community, Rev. 2', 2008), without making any exclusion regarding their size. Firms were contacted through a phone call to know whether they had ever implemented Lean techniques and to get the contact of the people in charge of the programme management. Then, the survey was sent via e-mail. Data were collected with the support of Lean Consultant Companies and Lean Institutes. In all, 171 completed questionnaires were returned from January 2016 to February 2017. If we consider that the addressees were worldwide firms, this result would seem extremely unsatisfying. However, according to Burgess-Limerick, Plooy, Ankrum, Malhotra, and Grover (1998), the sample was higher than 100 and, even though the response rate was lower than 20%, reliability was assessed. In terms of number of employees the sample results heterogeneous: in 61.40% of firms there are more than 250 employees, in 21.64% there are between 50 and 250 workers, between 50 and 10 in the 8.77% of the companies and the remaining 8.19% has less than 10 employees. Considering the turnover, results are quite similar: the 57.31% of the firms invoices more than 50,000,000 €, the 28.65% between 10 and 50 million, the 10.53% between 2 and 10 million, and the remaining 3.51% less than 2,000,000 €. We collected questionnaires from employees with different roles of the same company in order to have a different point of view of the same industrial context. Respondents had various roles in their companies: 18.15% classified themselves as Presidents/COOs/Plant managers, hence they belonged to Top Managers; 27.47% belonged to Middle Managers: in this group, the 18.71% was employed as Production control manager, 1.75% as information systems managers, 1.75% as quality managers, 0.58% as plant superintendents managers, 3.51% as plant accounting managers and 1.17% as inventory managers. The remaining 52.04% of the respondents were employed in non-managerial positions: 31.58% of the interviewed classified themselves as Lean specialists, 12.28% as Process engineers, while 5.85% belonged to Product development team. Smaller fractions of non-managers were represented by shop-floor personnel (1.75%) and secretaries (0.58%). The remaining 2.34% belonged to an unclassified position; hence they were excluded from the analysis.

4.3. *Measurement scale assessment*

Data collection and analysis were performed using SPSS and SPSS Amos. A Confirmatory Factor Analysis (CFA) was carried out in order to test the strength of the relations between the observed variables and the corresponding latent constructs identified through literature review (STRATEGIC BARRIERS, ECONOMIC BARRIERS, SUPPLY CHAIN INTEGRATION BARRIERS, HUMAN BARRIERS, CULTURAL BARRIERS, HARD LEAN PRACTICES, and SOFT LEAN PRACTICES). As noted before, barriers were treated separately considering both those related to start-up and sustaining phases. According to the procedure described by Hair, Black, Babin, Anderson, and Tatham (2006), a review of standardised regression weights of each item was carried out, and those observed variables whose values resulted lower than 0.5 were dropped. In particular, B1.A2 was excluded from HARD LEAN PRACTICES bundle, while C1.A6 and C1.E7 were

dropped respectively from STRATEGIC and CULTURAL BARRIERS of the start-up phase. For what concerning sustaining phases of lean projects, C2.C6, C2.C7 and C2.C8 were eliminated from SUPPLY CHAIN INTEGRATION BARRIERS, C2.D4, C2.D6 and C1.D10 from HUMAN BARRIERS, while C2.E8 from CULTURAL BARRIERS. Internal consistency reliability was established, calculating Cronbach's alpha: resulting factors were all above the recommended threshold of 0.7. Measures of Composite Reliability (CR) calculated for all constructs exceeded 0.6. Average Variance Extracted (AVE), instead, did not respect the recommended 0.5 thresholds for all latent variables. Indeed, values of 0.443, 0.486 and 0.490 were found for HARD LEAN PRACTICES, SOFT LEAN PRACTICES, and STRATEGIC BARRIERS to the sustaining phase. According to Fornell and Larcker (1981), if AVE assumes values lower than 0.5, but CR respects the recommended threshold (0.6), the convergent validity of the model is still adequate.

5. Results

In Figure 2a the trend of the scores assigned to the success perception of lean projects is presented, and it can be noted that Non-Managers provided the highest evaluation. On the other hand, Top-Managers assigned the lowest evaluation. The trend of the success perception of Hard and Soft lean practices is in line with the one of lean success. In particular, the most implemented Hard lean practices is the application of Just in Time delivery by suppliers, while the most common Soft lean practice is characterised by the training for employees. Soft lean practices also present a major variance in members of the Product Development team and Process Engineers' opinion: this aspect can be justified considering the difficulty to measure the actual results of qualitative and human-based practices. A similar attitude can be observed for what concerning barriers to lean implementation (Figure 2b and c): we can note that those who positively evaluated the degree of lean success also affirmed to have encountered a high level of difficulties.[1] Non-managers consider Supply Chain Integration barriers to be the less worrying both in the start-up and in the sustaining phases: items C1.C6 ('Ease in involving the entire supply chain because of Partnership or closer relations with carriers and logistics providers') and C2.C2 ('During the lean projects execution supplier act as the seamless extension of the refined lean system of Toyota'), in particular, received the highest evaluations. Strategic difficulties result in being the most concerning during the first stages of a lean journey and, specifically, the awareness of the need for a lean project (C1.A1 – 'An effective model or roadmap guides the future steps') is considered as the most significant criticism. During the sustaining phases, instead, the perception of Human aspects' criticism appears to increase in relevance, even though the item that received the lowest evaluation regards the application of performance measurement systems (C2.A2 – Performance measurement systems are used). The same trend is followed by both the Top Managers and the Middle Managers, evidencing a substantial agreement in the perception of the degree of strategic, human and supply chain integration difficulties experienced.

In order to test the hypothesis developed in Section 3, a One-way Multivariate Analysis of Variance (MANOVA) has been carried out for H1, H2a, and H2b, while a multi-way Analysis of Variance (ANOVA) was applied to verify H3a and H3b.

The independent factor considered in the MANOVA is the Respondent position, as this paper aims to analyze the presence of a biased effect due to the role played in lean projects. As dependent variables, we considered both answers provided to question 'Please indicate the percentage of the lean project successfully developed in your company' – labelled as

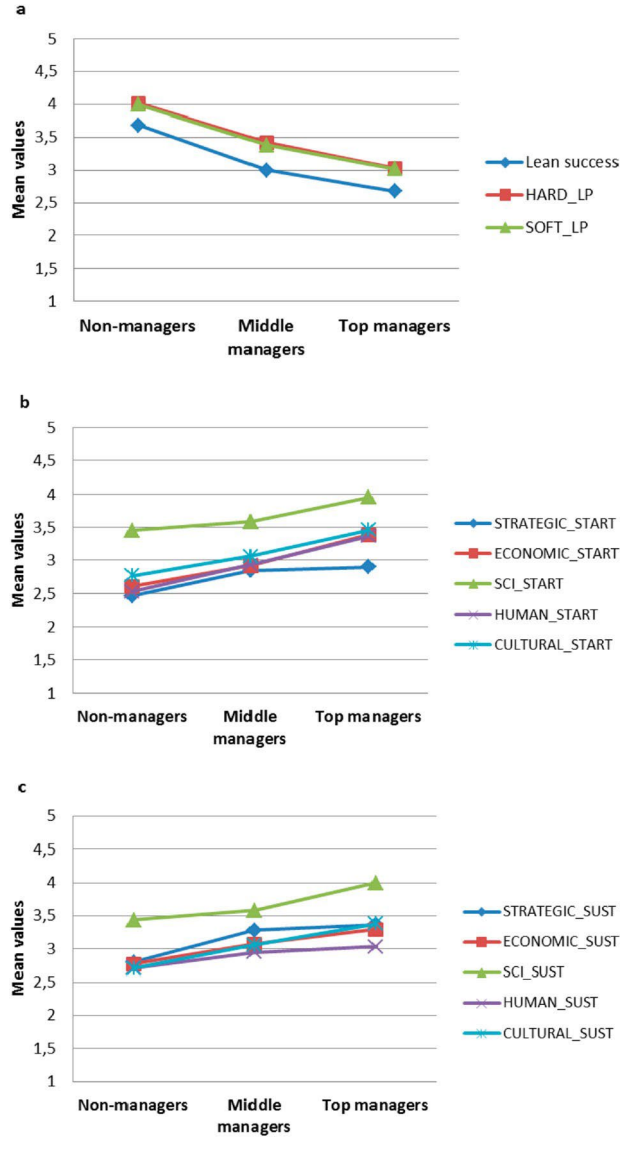


Figure 2. Respondents perception of lean projects success and practices implementation level (a), lean barriers during start-up (b) and sustaining (c) phases: average values.

Lean Success – and the mean values of barriers items listed in Table 2. It was found there is a significant difference in success, implementation level and barriers of lean projects based on the role of respondents. Indeed, we obtained $F(26, 304) = 2.244$, $p = 0.001$, Wilk's lambda = 0.704 and partial eta squared = 0.161.

Table 2 shows that Respondent Role has a significant impact on the majority of variables analysed, except for Supply Chain Integration barriers during the start-up phase of lean projects and for Human barriers encountered during the sustaining ones, presenting a p-value higher than 0.05 – respectively 0.061 and 0.162. For this reason, SCI_START and HUMAN_SUST were excluded from the following analysis.

Table 2. Significance of the dependency on respondent position and Lean success and barriers.

Dependent variable	Type III sum of squares	df	Mean square	*F*	Sig.	Partial eta squared
Lean success	29,46	2	14,73	15,69	0,000	0,161
STRATEGIC_START	6,896	2	3,448	3,697	0,027	0,043
ECONOMIC_START	14,68	2	7,34	7,076	0,001	0,079
SCI_START	5,756	2	2,878	2,849	0,061	0,034
HUMAN_START	17,444	2	8,722	9,012	0,000	0,099
CULTURAL_START	11,504	2	5,752	5,989	0,003	0,068
STRATEGIC_SUST	11,139	2	5,57	5,331	0,006	0,061
ECONOMIC_SUST	7,102	2	3,551	3,664	0,028	0,043
SCI_SUST	7,257	2	3,628	4,595	0,011	0,053
HUMAN_SUST	3,104	2	1,552	1,842	0,162	0,022
CULTURAL_SUST	11,562	2	5,781	7,255	,001	,0810

The method chosen to conduct pairwise comparisons was Games-Howell. The aim of the first hypothesis was to test whether the managerial role played by respondents had a significant impact on the way lean success is perceived. In other words, we want to test if the score assigned to the question 'Please indicate the percentage of lean projects successfully developed in your company' was biased by respondent position. The post-hoc analysis (Table 3) highlighted the existence of significant differences: multiple comparisons evidenced a significant difference between scoring provided by Non-Managers and Top-Managers and between Non-Managers and Middle-Managers. Hence, we can say that the H1 hypothesis is partially verified. Indeed, the comparison between Middle Management's and Top Management's perceptions does not present statistically significant differences.

In Tables 4 and 5, a pairwise comparison resulting from the one-way MANOVA between respondents' perception of barriers in START-UP and SUSTAINING phases are also reported. We can note that all factors present significant differences in pairwise comparisons. In particular, economic, human and cultural barriers are differently perceived by Non-Managers and Top-Managers (ECONOMIC_START: Mean difference = −0.787; SD = 0.212; $p = 0.001$; HUMAN_START: Mean difference = −0.842; SD = 0.226; $p = 0.002$; CULTURAL_START: Mean difference = −0.693; SD = 0.217; $p = 0.007$). These results evidence the reasonability of hypothesis H2a.

As we noted before, barriers can change during lean project implementation; hence our MANOVA included even difficulties encountered during the sustaining phases. Interestingly, even in this case, scoring provided by Top Managers and Non-managers were found to be significantly different for strategic (Mean difference = 0.564; SD = 0.197;

Table 3. Pairwise comparison between respondents perception of lean projects' success.

Dependent variable	(I) Responent position	(J) Responent position	Mean difference (I-J)	Std. Error	Sig.
Lean success	Non-managers	Middle managers	,685*	0,176	0,001
		Top managers	1,008*	0,184	0,001
	Middle managers	Non-managers	−,685*	0,176	0,001
		Top managers	0,323	0,204	0,262
	Top managers	Middle managers	−0,323	0,204	0,262
		Non-managers	−1,008*	0,184	0,001

Table 4. Pairwise comparison between respondents perception of barriers in START-UP phase.

Dependent variable	(I) Respondent position	(J) Respondent position	Mean difference (I-J)	Std. Error	Sig.
STRATEGIC_START	Non-managers	Middle managers	−0,384	0,177	0,081
		Top managers	−0,438	0,187	0,058
	Middle managerss	Non-managers	0,384	0,177	0,081
		Top managers	−0,054	0,210	0,964
	Top managers	Middle managers	0,054	0,210	0,964
		Non-managers	0,438	0,187	0,058
ECONOMIC_START	Non-managers	Middle managers	−0,319	0,182	0,189
		Top managers	−0,787*	0,212	0,001
	Middle managers	Non-managers	0,319	0,181	0,189
		Top managers	−0,468	0,232	0,117
	Top managers	Middle managers	0,467	0,232	0,117
		Non-managers	,787*	0,212	0,001
HUMAN_START	Non-managers	Middle managers	−0,402	0,176	0,063
		Top managers	−0,842*	0,226	0,002
	Middle managers	Non-managers	0,402	0,176	0,063
		Top managers	−0,440	0,251	0,195
	Top managers	Middle managers	0,440	0,251	0,195
		Non-managers	0,842*	0,226	0,002
CULTURAL_START	Non-managers	Middle managers	−0,296	0,177	0,22
		Top managers	-,693*	0,217	0,007
	Middle managers	Non-managers	0,296	0,177	0,22
		Top managers	−0,397	0,242	0,237
	Top managers	Middle managers	0,397	0,242	0,237
		Non-managers	−,693*	0,217	0,007

p = 0.015), supply chain integration (Mean difference = 0.562; SD = 0.162; p = 0.003) and cultural barriers. (Mean difference = 0.675; SD = 0.173; p = 0.001). Moreover, strategic difficulties are differently perceived also by Middle managers and Non-managers (Mean difference = 0.482; SD = 0.177; p = 0.02). These results allow us to affirm that H2b is also supported.

In order to test the assumptions contained in H3a and H3b, a multi-way ANOVA for each of the two hypotheses was carried out. Analyzing Tables 6 and 7, we can see that success perception depends on the percentage of success of both Hard and Soft lean practices. In particular, all hard lean practices (B1.A1: Setup time reduction/Single Minute Exchange of Die (SMED); B1.A3: Equipment layout for continuous flow; B1.A4: Statistical Process Control; B1.A5: Total Productive Maintenance; B1.A6: Just in time delivery by the supplier) have a significant impact on success perception., Also the implementation of Soft lean practices has an impact on success perception, as none of the variables' significances presents a p-value higher than 0.05.

6. Discussion

6.1. High-level perspective

In Table 8 a summary of the results obtained is reported. For each role of the respondents to the survey, the involvement degree to the lean project, the barriers level experienced, success perception, as well as the considered level of lean practices implementation, are reported. Besides, Table 8 assures a more direct representation of the results achieved by the study.

Table 5. Pairwise comparison between respondents' perception of barriers in SUSTAINING phase.

Dependent variable	(I) Respodnent position	(J) Respondent position	Mean difference (I-J)	Std. Error	Sig.
STRATEGIC_SUST	Non-managers	Middle managers	−0,482*	0,177	0,020
		Top managers	−0,564*	0,197	0,015
	Middle managers	Non-managers	0,482*	0,177	0,020
		Top managers	−0,082	0,204	0,915
	Top managers	Middle managers	0,082	0,204	0,915
		Non-managers	0,564*	0,197	0,015
ECONOMIC_SUST	Non-managers	Middle managers	−0,294	0,172	0,207
		Top managers	−0,521	0,216	0,051
	Middle managers	Non-managers	0,294	0,172	0,207
		Top managers	−0,227	0,234	0,600
	Top managers	Middle managers	0,227	0,234	0,600
		Non-managers	0,521	0,216	0,051
SCI_SUST	Non-managers	Middle managers	−0,145	0,168	0,665
		Top managers	-,562*	0,162	0,003
	Middle managers	Non-managers	0,145	0,168	0,665
		Top managers	−0,417	0,189	0,077
	Top managers	Middle managers	0,417	0,189	0,077
		Non-managers	,562*	0,162	0,003
CULTURAL_SUST	Non-managers	Middle managers	−0,353	0,163	0,081
		Top managers	−0,675*	0,173	0,001
	Middle managers	Non-managers	0,353	0,163	0,081
		Top managers	−0,322	0,192	0,223
	Top managers	Middle managers	0,322	0,192	0,223
		Non-managers	0,675*	0,173	0,001

Table 6. Significance of the dependency within lean success and hard lean practices.

Independent variable	Type III Sum of Squares	df*	Mean Square	*F*	Sig.
B1.A1	135,083	4	33,771	12,890	0,000
B1.A3	148,997	4	37,249	14,476	0,000
B1.A4	95,251	4	23,813	8,131	0,000
B1.A5	110,636	4	27,659	10,713	0,000
B1.A6	81,333	4	20,333	10,244	0,000

*Degree of freedom of the analysis between groups.

Table 7. Significance of the dependency within lean success and soft lean practices.

Independent variable	Type III Sum of Squares	df	Mean Square	*F*	Sig.
B1.A7	59,553	4	14,888	4,615	0,001
B1.A8	110,324	4	27,581	11,981	0,000
B1.A9	137,626	4	34,407	11,707	0,000
B1.A10	98,132	4	24,533	19,159	0,000
B1.A11	48,729	4	12,182	3,762	0,006
B1.A12	67,826	4	16,956	4,801	0,001

*Degree of freedom of the analysis between groups.

Table 8. Results summary.

Respondent role	Managerial position	Level of direct involvement in lean project	Lean barriers	Success level	Implementation level of lean practices
Lean specialist; Process engineers; Product developers; Secretaries; Shop-floor personnel	Non-managers	High	High	High	High
Production control managers; Information system managers; Quality manager; Plant superintendents; Plant accounting managers; Inventory managers	Middle managers	Medium	Medium	Medium	Medium
Presidents/COOs/Plant managers	Top managers	Low	Low	Low	Low

We can see how people in charge of lean projects – lean specialists, in particular – perceive a higher level of success from lean projects than other figures. These results present a considerable self-serving bias: indeed, company personnel directly involved and responsible for the lean project tend to recognise a high level of success. These results are in line with the trend to claim responsibility for success highlighted from other studies (Gok et al., 2012; Virine & Trumper, 2009). Top-Managers assigned the lowest evaluation, and, as mentioned before, this difference is statistically significant. Direct interviews with respondents allowed us to highlight that top managers like company's presidents or COOs do not follow the projects' progress directly, but often delegate these tasks to Non-Managers. However, they are responsible for some lean barriers such as the allocation of financial, human and time resources to each project. Thus, when the results are lower than expected, a self-serving attitude is revealed (Miller & Ross, 1975). Managers perceive that resources they allocated are sufficient for a successful deployment of the project; hence they deny their involvement in the unfulfillment of the prefixed goals.

Indeed, the actors who played an influential role in lean projects (lean specialists, in particular) reported having faced several barriers that can be attributed to environmental dynamics. On the other hand, the observers (Top-Managers), that are those less involved in lean projects' implementation, perceived a lower level of barriers. This difference can be imputed to the actor-observer bias (Jones & Nisbett, 1972), according to whom actors attribute their behaviours to situational conditions, while observers consider dispositional dynamics of the actors under their evaluation. Moreover, a typically self-serving biased behaviour is shown: people expect their actions to produce success (Miller & Ross, 1975); hence they may overestimate the degree of barriers encountered in order to justify their achievement. The fundamental attribution error, instead, was not evidenced by the results of the present questionnaire. It is characterised by the tendency to attribute the cause of some behaviour to internal characteristics, instead of taking into consideration situational dynamics (Ross, 1977).

6.2. Managerial implications

Nowadays, companies, who need to adapt to fast-changing patterns, and researchers, who aim at analyzing the current attitude of the industrial landscape, direct their interest to Lean philosophy. Liker (2004) highlighted that the main challenge to be faced in becoming Lean is 'how to create an aligned organisation of individuals who each have the DNA of the organisation and are continually learning together to add value to the customer'. Focus on people represents, in fact, one of the challenges to be faced by managers: indeed, human resource management and human-related practices have particular relevance in Lean Management (Bortolotti et al., 2015). For instance, communication and cooperation are vital to organisations' effective development: a breakdown of these critical issues can lead to the failure of the whole project.

Moreover, as we can highlight from the results presented in section 5 and discussed in section 6, it is vital for managers to be aware of the biases that affect their judgments (Bartunek, 1981). A combination of contextual issues and factors influencing perceptions should be applied by managers (Losonci, Demeter, & Jenei, 2011). Actually, in current conditions, both the perceptions of managers and non-managers are biased; hence an objective evaluation of lean implementation level, success and barriers faced is not available. More quantitative analysis could be proposed, but in contests like lean projects, it is rarely applicable. Indeed, quantitative measurements of performances, such as time improvement, can be extracted only for hard lean practices, but they cannot be calculated for soft lean practices, which deal with human-related and qualitative aspects. For these reasons, managers should be aware of the behavioural aspects and sociological implications that can have a relevant impact on projects' performances. Being aware of the existence of the attribution theory and making the consequent adjustment in the attribution style can lead to the strengthening of self-efficacy (Harvey et al., 2006) and, hence, to the enhancement of lean projects' effectiveness.

Managers' attitude towards their companies was found to be biased by the illusion of control (Messick & Bazerman, 2001): indeed, they perceived that their contribution is superior the other ones', whereas the failures are less relevant. Standing et al. (2006) studied the success evaluation of information technology projects and found that support workers are willing to take responsibility for success, attributing failures to external variables, re-creating their personal version of the events and their contributions, in a self-affirmation perspective (Knights, 1995). This aspect should be always taken into account since, in Barker and Barr (2002), it is stated that attributing failure to internal causes implies a greater strategic reorientation willingness. On the other hand, those who tend to overly blame failure are less likely involved in future projects and more exposed to stress issues. The idea of punishment for project failure in one of the triggers to biases growth, thus it is important to separate the benefit/punishment system from the effective evaluation of the projects' participants (Udo, 1993). Organisation willing to be innovative and to compete globally should bear in mind these considerations (Garcia-Morales, Llorens-Montes, & Verdu-Jover, 2006; Yang, Wu, Shu, & Yang, 2006): enhancing the feeling of success all along the lean journey (Losonci et al., 2011) guarantees the acceptance of a changing system and to maintain a high level of interest even during the sustaining phase of a project.

7. Conclusions and future research

7.1. Conclusion

Lean Management involves a wide number of dimensions, which all contribute to organisations' success. This work aims at connecting the managerial and sociological aspects

characterising the perception of success and difficulties of lean projects. Moreover, a set of advice for the management category is provided. After a literature review concerning barriers to lean implementation, a questionnaire was developed and submitted to international firms. Several aspects were evaluated by the interviewed companies, such as the percentage of successfully implemented lean projects, hard and soft lean practices implementation level and dimensions related to strategic difficulties, human barriers, supply chain integration barriers, and economic and cultural obstacles.

A Multiple Analysis of Variance (MANOVA) was applied in order to discover differences and similarities in lean project evaluations within non-managers and various categories of managers. Our results highlight significantly different perceptions of the analysed aspects. In particular, the lower is the direct involvement in the lean project, the lower the perception of success, barriers, and implementation level. On the other hand, the more involved figures referred to have experienced a higher level of barriers to lean implementation and to have achieved a higher level of success and implementation level.

These findings will allow managers to better understand the sociological implication due to the interaction between people involved in a project, in order to begin and successfully carry on an improvement process in general and, specifically, a lean journey. Understanding this need, organisations will be able to face difficulties encountered during the programme deployment and to treat them with more confidence and consciousness: indeed, thanks to the contribution offered by this work, top management will be aware of the difference in perceptions of members of different areas in each phase and of how to deal with relational problems or inconvenience. Managers' support and motivation become key aspects of lean projects' deployment.

7.2. Limitations and further research

Despite the usefulness of this research, some limitations suggest that caution in interpreting its findings is needed. Indeed, the sample of companies investigated is relatively limited, as it is composed of only 171 samples. An enlargement of the sample per industrial sector would increase the relevance of the findings and it can allow developing specific analysis for every industrial sector: the culture in some industrial sectors might be more averse to change, while others may result more open, thus an enhanced study would allow a broader understanding of the lean panorama. Moreover, none of the questions made direct reference to dispositional characteristics or to personality traits: including in the survey this kind of information could allow in scaling the responses based on the psychological traits of the respondent.

The current study focuses on a specific category of projects, which includes lean practices implementation projects, since the broad interest in lean tools among manufacturing companies. Further development of the current approach may regard the analysis of managers attitudes towards other kinds of projects (i.e. ISO 14000 or OHSAS18000 implementation projects), in order to identify common traits and differences in their behaviours: even if the current study provides a roadmap for assessing success' and barriers' perceived levels on a project, the survey was specifically deployed for lean projects, so questions are specific for this field. Dedicated surveys are needed to understand if projects' evaluation is consistent and, possibly, a comparative study may be interesting to identify common traits and differences.

Note

1. As we can note from questions reported in supplementary material, a low score assigned to lean barriers represents a high level of difficulty encountered.

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