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How has social media been affecting problem-solving in organizations undergoing Lean Production implementation? A multi-case study

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ABSTRACT

This paper investigates the impact of social media utilization on problem-solving routines in organizations undergoing Lean Production (LP) implementation. A multi-case study was conducted in three firms from different sectors with distinct maturity levels of LP implementation. Empirical evidence was collected through complementary ways, such as semi-structured interviews, secondary data, and *in loco* non-participant observation. Data were then analyzed and triangulated, leading to propositions on the effects of social media on problem-solving activities in lean organizations. This research was grounded on the concepts of Information Manipulation Theory. Our findings suggest that, while social media may contribute to the amount of information that is shared for solving problems, the relevance and the level of details of such information may be shallow, overburdening the help chain mechanisms and generating wastes like overprocessing. The identification of the impact of social media on problem-solving activities enables a better comprehension of how new information and communication technologies can promote (or impair) the intra- and inter-organizational links. It also helps identify improvement opportunities in integrating social media into problem-solving routines, resulting in more responsive and competitive organizations.

1. Introduction

With growing diffusion of Lean Production (LP) in the last three decades, organizations from different industry sectors have been pursuing the implementation of practices and principles to continuously improve products, processes, and services through active people engagement and development [1–3]. Organizations undergoing LP implementation are usually characterized by higher levels of process standardization and transparency, which facilitate the rapid identification of abnormalities and consequently foster problem-solving activities thereafter [4,5]. In addition, relentless reflection over the performed activities allows these companies to learn from previous failures (or success), yielding more consistent and sustainable improvements [6,7].

One of the main practices that structures and facilitates problem-solving in organizations implementing LP is the help chain (HC), replacing traditional chains of command with chains of support. HC is an interactive and engaging routine adopted among various organizational levels to quickly solve problems whenever they arise, re-establishing the flow of value [8]. When the HC is incorporated into the management daily routine actively involving all employees, it enhances process stability, structuring an approach for identification, registration, and resolution of problems [9,10]. Therefore, a key requirement for the HC to

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succeed is the establishment of clear communication channels and instances across the organization [11].

The use of new information and communication technologies (ICTs) such as social media has changed how people communicate and connect, as they promote user-driven online networks for multi-actor engagement [12,13]. These networks may work as open communication spaces, supporting equal access to information and free information sharing to integrate knowledge and jointly solve problems as well as widely and speedily disseminate solutions. Nevertheless, this informal networking may encompass multiple individuals who bypass the organization's official communication chain to support intra- and inter-organizational linkages [14]. If not properly conducted, the integration of social media can generate paradoxical effects on the company's ability to solve problems. On the one hand, such bypass might contribute to equal access to information and information sharing so that knowledge is disseminated and integrated [15,16]. On the other hand, it might result in misguided shortcuts that can increase organizational redundancy and generate wasteful initiatives to solve existing problems [17]. Therefore, the inadvertent utilization of social media in organizations as a supporting tool to problem-solving may conflict with the standardized HC routines in organizations undergoing LP implementation.

A few researchers have tangentially approached such a paradoxical relationship. For instance, Janssen and Estevez [18] reported the case of governments that have been adopting LP concepts and using social media as a means to raise and solve problems identified by citizens, hence, monitoring the collaborative actors and the interactions among them. Meissner et al. [19] explored, through a literature review and interviews with experts, digital problem-solving management and emphasized that network building supported by social media is one of its main benefits. Potter [20] investigated how effective lean managers are at developing a highly skilled workforce that is trained in LP skills using data from a social media platform utilized by employees from firms in the Toyota's supplier association. Despite these initiatives, evidence of the actual effects of social media on the problem-solving activities in lean organizations is relatively scarce in the literature, motivating the emergence of the following research question:

RQ. *How has social media been affecting problem-solving in organizations undergoing LP implementation?*

To answer this research question, we examined the effects of social media utilization on problem-solving routines in organizations undergoing LP implementation. A multi-case study was conducted in three firms from different sectors with distinct maturity levels of LP implementation. Empirical evidence collected through complementary ways, such as semi-structured interviews, secondary data, and non-participant observation, were analyzed and triangulated, leading to propositions on the effects of social media on problem-solving activities in lean organizations. This research was grounded on the concepts of Information Manipulation Theory (IMT) [21,22], which state that most information encompasses complex combinations of aspects that fall between truths and lies. IMT also argues that a person may adopt four different ways to persuade or deceive others [23,24], which are categorized according to: (*i*) quantity, (*ii*) quality, (*iii*) relation, and (*iv*) manner. Due to the theoretical relevance and conceptual suitability, our study used these four conversational maxims to frame information drawn from the case studies.

Identifying the effects of social media on problem-solving activities in organizations undergoing LP implementation allows a better understanding of how ICTs can foster (or impair) the intra- and inter-organizational links in HCs. While social media may favor the amount of information being shared, the relevance and the level of details of such information may be low, overburdening the HC mechanisms and generating wastes in the organizations like overprocessing. Based on the commonalities found in the case studies and aligned with IMT's concepts, formulating general propositions enables further theory testing and validation, adding to the body of knowledge on the field. Furthermore, our empirical examination also highlights existing opportunities in integrating social media to catalyze HCs and facilitate the problem-solving process, raising awareness of practitioners, hence, implying managerial contributions.

The rest of this paper is structured as follows. Section 2 brings the conceptual background on the main topics approached in the study. Section 3 describes the methodological approach, while Section 4 presents the case studies investigated and the results. Section 5 discusses the findings, giving rise to our propositions. Lastly, Section 6 concludes the work and raises future research opportunities.

2. Background

2.1. Problem-solving in lean organizations

Problems constantly arise in organizations, usually represented by a gap between the actual state and some desired or expected state. When such a gap is hard to be fulfilled and sufficiently relevant to be part of individuals' concerns, a problem is formally identified [25,11]. The adequate and timely identification of a problem is the very first step towards its resolution. The incorrect or late identification of a problem can yield severe implications for organizations [26–28]. In fact, according to Spear [29], the careful design of processes so that abnormalities are easily identified is one of the main abilities of leading organizations, followed by systematic problem-solving and knowledge sharing, also contributing towards the development of new leaders. Nevertheless, as organizations increase the number of employees, processes, and products, redundancies and/or gaps of communication and responsibility may emerge, jeopardizing the effective problem-solving [30]. The rise in organizational complexity also tends to require the development of new process and behavioral standards, which might entail additional learning challenges [31,32].

A lean organization is mainly characterized by continuous efforts to improve its value stream by eliminating waste according to customers' requirements through active people engagement [5,3]. A pillar of a lean organization is called *jidoka*, which refers to the ability of stopping processes whenever problems occur so that they can be addressed before moving downstream [33,34]. Within this pillar, the HC promotes a sense of urgency and discipline, turning problem-solving activities into an everyday practice in the lean organization [8]. Supported by the *andon*, manually or automatically activated system (e.g., pullcord or button) that notifies leadership and employees when a problem occurs [6], the HC establishes a clear rationale and mechanism to solve problems of a given criticality by encompassing the right information, methods, and individuals. For that, the definition of unambiguous roles, communication channels, and process outcomes at each organizational level is a fundamental requisite [35]. In other words, a standardized and organized set of countermeasures must be designed so that employees get involved optimally, following a sequence that goes from the operators to the senior managers [11]. The main problem-solving activities in a HC can be categorized as (*i*) problem identification/registration, (*ii*) problem communication/escalation, (*iii*) problem resolution, and (*iv*) solution standardization and learning [36,37].

Another common approach to problem-solving in lean organizations is the A3 management [38], which provides leaders with a step-by-step problem-solving process closely modelled on the Plan-Do-Check-Act (PDCA) [39]. The A3 management first and foremost teaches leaders to "go and see" at the *gemba* (the real place) to comprehend the real nature of a problem, how to analyze it, and how to take effective initiative to develop countermeasures and improve the situation [40]. A3 management also serves as an important means of communication – such that countermeasures developed during the problem-solving activities can be standardized and shared with others [41]. Richardson and Richardson [39] present this form of "standardized storytelling" as a powerful tool to engage and empower leaders and front-line personnel.

Many researchers have reported evidence of problem-solving in lean organizations. For instance, Worley and Doolen [37], based on a study

conducted at an electronics manufacturer in the USA, described lean implementation's role as a catalyst for developing employee problem-solving skills. Huo and Boxall [42] discussed the effects of problem-solving demands and job resources (training, participation in decision-making, and line manager support) on employee engagement and exhaustion in a Chinese manufacturer undergoing lean implementation. Iuga and Rosca [43] compared problem-solving tools in lean organizations, categorizing them according to their orientation in terms of complexity, creativity, immediate solution and/or root cause analysis. This allowed the identification of the adequacy of the tools according to the problem to be solved. Powell and Coughlan [44] also present practical insights and implications for learning and continuous improvement with regard to problem-solving activities in corporate lean programs.

Overall, given that it is the rationale behind the problem-solving activities that is the most important, organizations might consider their learning capabilities [45]. Whereby A3, PDCA, HC, etc., serve as problem-solving techniques and a means of creating problem-solvers, Toyota Kata (improvement- and coaching kata) has emerged as an approach to create scientific thinking capabilities in people [40,7,44]. Rother [46] suggested that managers in lean organizations' primary task revolves around increasing people's improvement (problem-solving) capability, and presents the coaching kata as a mentor/mentee dialog for teaching the improvement kata.

2.2. Social media and problem-solving

Social media denotes the means of interactions among people in which they create, share, and/or exchange information and ideas in virtual communities and networks [47–49]. Considering the technological developments in the past decade, social media is considered a tool that enables the exchange of information and knowledge creation between individuals and organizations, especially when knowledge is highly dispersed among different stakeholders [50]. It can be a driver (i.e., an initiating instrument that stimulates the firm to engage in a process) and/or an enabler (i.e., a supporting instrument that facilitates the implementation of activities in the development of that process) [51]. Social media connects and interacts within and outside organizations, thus improving collaboration efforts and reducing collaboration costs in groups of diverse stakeholders [52,53]. Similarly, social media contributes to organisational value creation and innovation through enhanced business intelligence and knowledge management [54,55]. Through promoting communication and connecting individuals and organizations, social media is a vessel for gaining customer insights, accessing knowledge, developing new ideas and concepts together with users, and boosting product/service commercialization [56,57]. It has been used in organizations for socialization, knowledge transfer, and managerial power enactment [58,48]. For example, Procter and Gamble's Connect + Develop platform enabled the co-creation of new ideas swiftly and at a relatively low cost with consumers worldwide [50].

Social media has also been a prominent facilitator of problem-solving due to its open communication nature, as exemplified in Table 1. Much of the existing literature has approached this relationship in educational contexts (e.g., [59–61]). Very few authors have investigated the role of social media in problem-solving activities in businesses and organizational settings. Such a scarcity of studies is inconsistent with the growing adoption of social media in organizations. Kane et al. [62] indicated that

Table 1
Examples of studies on social media utilization as a supporting tool for problem-solving in organizations.

Reference	Objective	Research Method	Findings
Jewpanich and Piriyasurawong [59]	To develop the project-based learning using discussion and lesson-learned methods via social media model used for enhancing problem-solving skills of undergraduate in education student.	Nine experts in education, enhancement of problem-solving skills, educational technology, and computer and communication technology were selected by purposive sampling. The collected data was statistically analyzed.	Results suggested that the developed learning model was rated as most appropriate particularly in terms of quality.
Gaál et al. (2015)	To investigate the role of social media in knowledge sharing to facilitate collaboration in organizations	An online survey with 299 individuals participated in.	Employees prefer to use external social media to support knowledge sharing
Sin [17]	To verify whether the level of problematic informational outcomes varies with the use of social networking sites, microblogs, and social question and answer sites.	An online questionnaire was utilized to survey 791 undergraduates. Multivariate data techniques were used to analyze the dataset.	Results indicated notable problem-solving style differences, especially on the Personal Control subscale.
Lee et al. [60]	To examine a collaborative problem-solving case using social media and an e-collaboration tool, analyzing its educational implications.	A case study was conducted in a middle school class. Two rounds of one-to-one interviews with a teacher and written interviews with students were conducted.	The use of social media and an e-collaboration tool could encourage students' scientific inquiries and enhance problem-solving skills as well as set up a healthy communication culture among teachers and students.
Panaoura [61]	To understand the relationships between parental involvement during the school homework in mathematics with students' perseverance in problem-solving ability in mathematics and their self-regulatory performance in problem-solving.	Data were selected by 183 students at the 5th grade and one of their parents, being analyzed via dynamic modeling.	Parents' beliefs, students' self-regulation and their problem-solving persistence were interrelated at each one of the measurement waves and growth in each of the ability was affected by the state of the others.
Li et al. [16]	To identify the relationships between many social factors and the occurrence of collaborative problem-solving by drawing on different social theories.	A dataset including 10,101 actual problem-solving scenarios across 519 social media groups was analyzed using multilevel logistic regression.	Quality and decentralized degree of social interactions in a social media group can increase the likelihood of collaborative problem-solving.
Koehler and Vilarinho-Pereira [15]	To identify prominent educational affordances of social media and to explore their potential to support ill-structured problem-solving activities.	A literature review and a discursive narrative were conducted to analyze the associations.	Findings offer researchers and educators new directions for facilitating problem-centered learning when using social media.
Munthali et al. [14]	To examine the contribution of two social media messaging platforms to facilitating open information sharing and interaction amid the emergence of a new pest.	Using thematic content analysis and network analysis, the types of content exchanged over the platforms and their characteristics were analyzed.	Both social media platforms are characterised by centralized network and communication structures, suggesting that participation in sending messages is non-egalitarian. Such structural features are not conducive to complex knowledge and problem-solving processes.
Adikari et al. [67]	To explore the effects of social media on value co-creation for open innovation in organizations	Secondary data via 36,100 posts	The findings show that using machine learning algorithms to generate actionable insights of strategic value from social media for open innovation

87% of maturing companies adopt social media to foster innovation, and 60% incorporate them into operations. Findings from Ali et al. [63] corroborated these indications by highlighting the importance of social media for innovation performance and problem-solving. Munthali et al. [14], in particular, studied the contribution of two social media messaging platforms to facilitate open information sharing and interaction amid the emergence of a new pest in Ghana. In opposition, Yang et al. [64] suggested that, due to content saturation, social media's true meaning concerning business data is hardly ever found, which raises some limitations in its utilization. This issue was also pointed by Diviák [65]. Obermayer et al. [66] raised the issue of information overwhelming created by the adoption of social media in organizations, which might affect the quality of their services and processes.

Overall, existing evidence suggests that social media may support knowledge processes (Gaál et al., 2015; [68]), and is likely to create helpful input for knowledge integration and collaborative problem-solving, complementing face-to-face interactions [16,17]. Adikari et al. [67] investigated the role of social media on value co-creation for open innovation in organisations. In fact, Goode [69], proposed that open source users may have more extensive knowledge-sharing and teamwork practices in place and are more tolerant of risk, which is aligned with the assumption that social media may support a more collaborative workplace. However, due to the lack of research in organizational contexts, our study examines the impact of social media utilization on problem-solving routines in organizations undergoing LP implementation.

2.3. Information manipulation theory

Deceptiveness can be understood as a message property that refers to a type of adaptation to the demands of complex communication cases [70]. In such cases, individuals must reconcile the competing goals of conveying information that their conversational partners supposedly should have, quite often altering it. The intensity of manipulation and control of this information may characterize deceptiveness [21]. IMT is the theory of deceptive discourse elaboration, which is likely to succeed if those manipulations remain undetected by recipients [71,72].

Individuals may have four main ways to manipulate information and mislead others [22]: (*i*) quantity, which refers to playing with the amount of relevant information that is shared, (*ii*) quality, which represents the inclusion of false information, (*iii*) relation, which indicates the presentation of irrelevant information, and (*iv*) manner, which denotes the presentation of information in an overly vague fashion. Among those, quantity violations are the most usual form of deceptive discourses, since individuals tend to edit-out problematic information as they communicate (also denoted as "white lies"). As the manipulation of quantity is very difficult to be detected, the identification of deception embedded into daily communication is likely to be poor [73]. Additionally, deceivers often utilize messages entirely comprised by truthful information to deceive, undermining the ability to detect deception in real-world environments [74].

In face of existing criticism (including their own), McCornack et al. [24] conceived IMT2, which offered complementary concepts to IMT. For instance, IMT2 consisted of three propositional sets grounded on the following assumptions:

i) In situations where the truth is problematic (i.e., individuals may face significant issues for sharing it), deceptiveness is likely to be more cognitively efficient than truth-telling;
ii) Deceptive discourse is incrementally built as the information is shared, leading individuals to incorporate small pieces of false information into otherwise truthful discourse streams as they communicate; and
iii) Although the deceptive intent does not occur beforehand, it may emerge and decay at any point of the discourse production process.

Therefore, due to the academic pervasiveness and practical implications of its concepts, we adopted IMT as a theoretical lens to analyze our study's phenomenon of interest.

3. Research method

Due to the paucity of works on the effects of social media to problem-solving activities in lean organizations, a qualitative approach was adopted, which is aligned with our study's exploratory and descriptive nature [75,76]. We developed upfront a theoretical model (see Fig. 1) to frame our research design [77], enabling a more comprehensive understanding of the practical and theoretical contributions of the use of social media to the main problem-solving activities embedded in a HC [36,37].

A multi-case study approach was applied to answer the research questions, as it facilitates the emergence of propositions instead of quantitatively posing statistical findings [78]. Multiple case studies reinforce external validity and mitigate observer bias, allowing the establishment of more robust and testable theories [75]. In this sense, our indications should not be regarded as "proof" in a statistical sense [79], but allow building theoretical premises which help make assertions about the investigated phenomenon [80]. The research method comprised three main steps: (*i*) selection of case studies; (*ii*) data collection, and (*iii*) content analysis and data triangulation. These steps are subsequently detailed.

3.1. Selection of case studies

To ensure that the case studies offered a sufficiently relevant context of analysis to support answering the research question, we predefined some inclusion criteria. First, due to our study objective, we solely encompassed companies that have been utilizing social media (e.g., WhatsApp, Twitter, Slack, and Facebook Messenger) as an inter- and/or intra-organization communication tool. Unlike traditional communication tools like shared files and e-mails, closed access social networks allow employees to easily organize into groups to tackle specific projects or objectives, while minimizing the risks of information security breaches that open access ones would create [64]. Second, all companies should have been implementing LP for at least five years. In particular, the selected companies should have already implemented the HC as part of their daily management routines. Due to the required maturity in lean implementation and social media adoption, no distinction between manufacturing or service industry was made, allowing us to propose more generalizable indications about the relationship between social media and problem-solving in lean organizations. Third, since the socioeconomic context where the company is located may affect the LP adoption level [81] and the communication patterns [82], we focused on companies located in a same country. The numerous studies on LP implementation (e.g., [83,84]) together with the wide utilization of different social media (e.g., [85,86]) make the Brazilian context a reasonable socioeconomic context for our research. However, as social media has been used by a wide variety of companies and contexts, our study was not restricted to companies from a specific industry sector. This would add some heterogeneity to our sample, allowing the development of broader propositions and preventing the inherent limitations of an over-homogeneous dataset.

Convenience sampling is a non-probability sampling method where units are selected for inclusion in the sample because they are the easiest for the researcher to access [87]. Due to geographical proximity, availability at a given time, and willingness to participate in the research, such an approach was adopted in our study. In each organization, the most representative value stream was selected so that the corresponding problem-solving activities and the effects of social media adoption could be analyzed. To determine such representativeness, criteria such as revenue participation, volume, number of products and processes, and frequency of problems, were utilized [88]. In addition, at

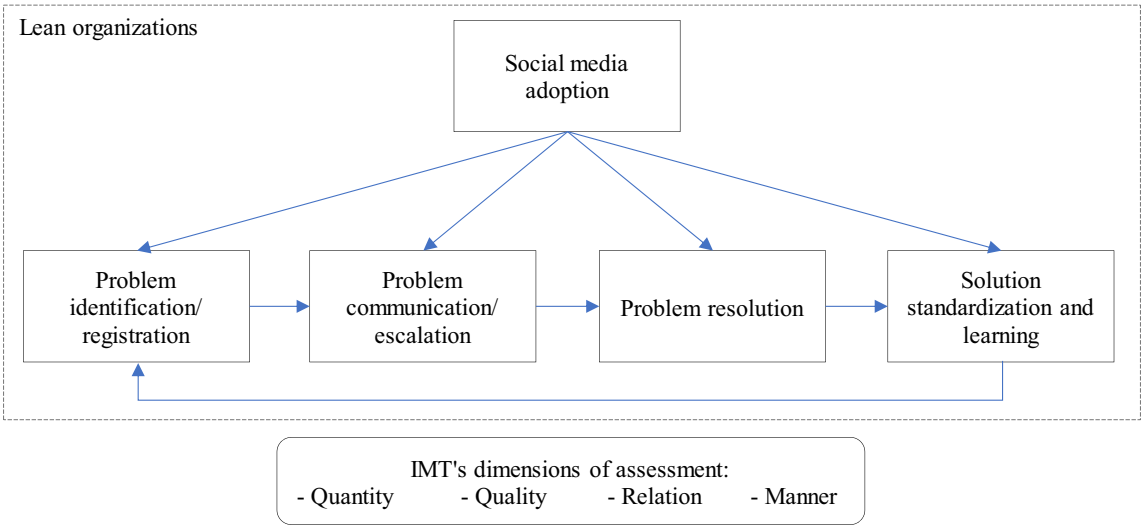

Fig. 1. Investigated conceptual model.

least three experienced employees (i.e., minimum of five years in the company) directly related with the selected value stream would participated in the study. We sought to include employees from the organisation's operational, tactical, and strategic levels to allow a more holistic view of the phenomenon.

3.2. Data collection

In this step, we gathered data from the selected case studies. For that, different means were used to collect data from multiple sources of evidence, such as semi-structured interviews, secondary data, and non-participant *in loco* visits, so that complementary information on the case studies could be compared (see Table 2). This also allowed us to more easily identify commonalities, and perform an in-case and cross-case analysis.

Regarding the semi-structured interviews, those were conducted online during June 2022 following a protocol with open-ended questions (see Appendix). Questions were grouped into three main parts. The first part asked about the interviewees' professional background, general characteristics of the studied value stream, and the conducted problem-solving activities. The second part sought information about the utilization of social media in the main problem-solving activities (i.e., problem identification/registration, problem communication/escalation, problem resolution, and solution standardization and learning – [36,37]) related to the selected value stream in the corresponding organization. The third part encompassed questions on the impact of social media adoption in terms of the quantity, quality, relation, and manner of the information (main ways to manipulate information according to IMT – [70]) in problem-solving activities. The same set of questions was used for all interviews, which were audio-recorded and lasted between 20 and 40 min. No ideas from previous interviews were either mentioned or incorporated into subsequent ones [89]. At least two of the authors were always present in the interviews to improve the reliability of the collected data [90]. All interviewees signed a consent form prior to their participation. Interviewees' anonymity was ensured to obtain candid responses. Any classified information commented during the interviews was omitted to assure confidentiality.

In terms of secondary data collection, we gathered information from the selected value streams (e.g., number of steps and people involved, frequency and criticality of the considered problems, skill level of the employees, operational performance indicators, among others) and the related problem-solving activities (e.g., effectiveness of problems solutions, number of levels for problem escalation, among others). Such data was inputted in the triangulation with the evidence gathered from the interviews and non-participant *in loco* visits.

Finally, concerning the non-participant *in loco* visits, each organization was visited by researchers. Those visits aimed to seek examples that could support the information provided in the interviews and confirm the trends observed in the secondary data. Hence, we verified the meaning of observations to avoid potential drawbacks [91]. Further, non-participant *in loco* visits increased the researchers' familiarity with the phenomenon under investigation, enabling better contextualization of the collected information.

Table 2
Data collection methods and the desired information.

Information	Semi-structured interviews	Secondary data	Non-participant *in loco* visits
Characteristics of interviewees	√		
Characteristics of the studied value stream	√	√	√
Characteristics of the problem-solving activities	√	√	√
Extent of social media in the problem-solving activities	√		√
Impact of social media adoption	√	√	√

3.3. Content analysis and data triangulation

The information recorded from the interviews was transcribed so that we could qualitatively analyze and discuss it. We disregarded idiosyncratic responses to focus on dominant patterns among interviewees. We then summarized and consolidated it after reaching a consensus on the main findings [92]. This allowed the categorization, tagging, and thematic analysis of qualitative data [93], yielding the identification of communication patterns that occur in a replicable and systematic manner and a narrative for data analysis [94]. Such qualitative content analysis helped understand the latent interpretations' intricacies and meanings [95]. We manually coded findings based on the excerpts from the transcripts, using words and short phrases as labels due to the ease of organization [96]. These codes were grouped into categories used to organize results into two meaningful information blocks: (*i*) extent of social media adoption in problem-solving activities, and (*ii*) impact of social media adoption on problem-solving activities.

The entire content analysis of the interviews was independently carried out by two of the researchers, whose codes and arguments were consolidated by a third researcher establishing consensus and consistency on the reasoning for the findings [97].

Next, we compared the information gathered from the secondary data and non-participant *in loco* visits with the outcomes from the semi-structured interviews, allowing the data triangulation. Triangulation can be defined as the utilization of different methods to examine the same phenomenon, increasing the research's credibility [98] and supporting the development of a chain of evidence [99]. Excerpts from narratives, insights, ideas, arguments offered by interviewees, and data sources were revisited to determine data documentation both in-case and cross-cases [100]. The commonalities among all sources of evidence for the extent of social media adoption in problem-solving activities were categorized in three classes [101]: (*i*) not explicitly evidenced, (*ii*) briefly evidenced, and (*iii*) highly evidenced.

Finally, based on the briefly and highly evidenced associations, we categorized the impact of social media adoption on problem-solving activities in organizations undergoing LP implementation as 'positive' (i.e., social media adoption is likely to favor a specific problem-solving activity from a given IMT dimension) or 'negative' (i.e., social media adoption is likely to undermine a specific problem-solving activity from a given IMT dimension). This helped formulate general propositions from the standpoint of the IMT, which could be used as input for future theory testing and validation.

4. Case studies description and results

Three organizations located in Brazil that met the aforementioned criteria agreed to participate. It is important to mention that the researchers were already familiar with these organizations due to previous research and consultancy activities. This allowed a much deeper understanding of their processes and routines, which facilitated the analysis and data collection raising additional insights to the study. Fifteen experienced employees from these organizations joined the interviews, and the characteristics of each case study are shown in Table 3.

4.1. Case study A

Case study A was a large-sized multinational tobacco manufacturer with two sites in Brazil. This company has been implementing LP for seventeen years in the shopfloor and administrative offices, primarily focusing on practices that favor process stability (e.g., 5S, visual management, standardized work, total productive maintenance, etc.). As part of such implementation, they have designed and standardized the daily management routine of the factory, defining scopes, metrics, procedures, and frequencies for sharing information and addressing problems. In the last five years, the organization has formally adopted a social media (WhatsApp) as a means to share information among frontline leaders, and middle and senior managers, who usually receive a company mobile. Hence, different communication groups were formed based on work affinities and roles, to supposedly catalyze collaboration and problem-solving activities.

The selected value stream for analysis was the final production line, comprised of a three shift-team with eight employees in each shift properly trained in their respective machines. This highly automated line produces approximately one hundred thousand cigarettes per shift. It presents an overall equipment effectiveness around 72% and, among the main reasons of losses, maintenance stoppages (i.e., corrective maintenance) in the bottleneck operation represent 40% of the downtime. This justified the investigation on the problem-solving activities related to this issue. A production supervisor directly leads each work shift and has four maintenance technicians (two mechanical and two electronic technicians) who provide support not only to this production line but to the entire manufacturing unit, hence, being shared resources. Five interviewees participated in the study: at the operational level, two operators and one maintenance technician; at the tactical level, one production supervisor; and at the strategic level, the manufacturing manager.

When maintenance problems occur in the production line, operators are supposed to be the first to try to solve them so that the production bottleneck remains running. If a solution is not found in ten minutes, operators must pull the *andon* and require help from the team leader assigned to that production line. The team leader, a more experienced employee, has up to thirty minutes to solve the problem. Similarly, if the problem is not solved within this time, the team leader contacts the production supervisor of the shift, briefing him about the nature of the problem. The production supervisor then decides from whom support is needed, e.g., in case of a mechanical issue in the machine, the mechanical technician of the shift will be called. For that, he contacts the maintenance technicians through the existing group in WhatsApp, which involves all leaders (e.g., team leaders, production supervisors, maintenance technicians) of a given work shift. The required technician goes to the stopped production line and starts working on the problem. If a countermeasure is not implemented up to two hours, the maintenance coordinator is then notified by the production supervisor through a different WhatsApp group that encompasses the middle management of the company (e.g., supervisors and coordinators). The maintenance coordinator is expected to find alternative solutions or seek for additional specialized support. When downtime exceeds one work shift, the manufacturing manager is informed via a direct message in WhatsApp, so that he can further escalate the problem in the organization.

Table 3
Case studies' characteristics.

Case	Sector	Size	Selected value stream	Utilized social media	LP implementation	Interviewee	Role	Experience
A	Manufacturing - Tobacco	> 500 employees	Final production line	WhatsApp	17 years	A1	2nd shift maintenance technician	15 years
						A2	1st shift production supervisor	18 years
						A3	Manufacturing manager	21 years
						A4	1st shift operator	13 years
						A5	2nd shift operator	17 years
B	Service - Software	> 500 employees	Software development	Slack	12 years	B1	Project manager	16 years
						B2	Customer success analyst	8 years
						B3	Customer success manager	6 years
						B4	Software developer	7 years
						B5	Software developer	11 years
C	Service - Healthcare	> 500 employees	Emergency room	Facebook Messenger	14 years	C1	1st shift technician	12 years
						C2	3rd shift technician	15 years
						C3	2nd shift nurse	8 years
						C4	Physician	7 years
						C5	Emergency room manager	17 years

Specifically regarding the utilization of social media in the problem-solving activities in this organization, it seems that it has been more helpful in the communication and escalation of problems. As emphasized by A2:

> "*Social media has been a helpful tool to communicate problems to the maintenance team. We are expected to communicate through it, minimizing ambiguities in the communication channels. Further, if the required technician is busy helping on another issue, others may be aware of the problem and step up. However, this is not always clear and may depend on the employees' initiative.*"

Regarding problem resolution, social media appears to offer an alternative way to share ideas and register what has been done to address problems. Nevertheless, A1 mentioned that this is not always done, which suggests some inconsistency in the existing procedure. This issue may also be observed in the solution standardization and learning, since only part of the information about what has been done in the machine is shared via social media. The other part is usually registered in the maintenance technicians' backlog, generating gaps or redundancies in the information.

Concerning the impact of social media, most interviewees highlighted that it has helped increase the frequency and amount of information shared throughout the HC. However, such fact does not necessarily mean that individuals are better informed and problems are resolved more quickly, as posed by A3:

> "*Sometimes, the use of social media can be overwhelming. Leaders may misguidedly send messages and share information through the groups with individuals not directly related to the problem. Leaders mistakenly believe that, because the message was sent through WhatsApp, then the responsible for the problem-solving activity will naturally emerge. They must understand that nothing replaces face-to-face exchange. Social media should be used as an additional communication resource and not as the main one.*

Another issue observed was that social media's impact was predominantly adopted in the tactical and strategic levels. Although maintenance technicians had access to social media and interacted through it, operators were not expected to use it. Therefore, since operators were often the first ones to identify problems in the production line, the benefits of social media for problem identification and registration were not as apparent. Additionally, its impact on problem-solving activities at the operational level was not so prominent.

4.2. Case study B

Case study B was a large-sized service organization located in the South of Brazil that has provided customized software solutions for over thirty years. It initiated its LP implementation twelve years ago, prioritizing efforts to improve information flows within the company and with customers. Hence, LP practices such as process mapping, cross-functional teams, standardized work, and visual management have been mainly adopted. Being predominantly a project-oriented company, work teams are specifically assembled according to each project, being disassembled after its completion. To avoid long learning curves, a HC has been designed, standardizing the problem-solving activities regardless of the composition of the teams. This has helped the company to increase consistency on its processes. As one of the main communication support tools both within the organization and with customers, a social media (Slack) has been used for six years.

Due to the company's purpose, the main value stream corresponds to software development, which was selected for our study. Being a transactional process, which (in contrast to physical manufacturing) transforms information and data [102], this value stream is usually composed by seven main activities: (*i*) requirement analysis, (*ii*) resource planning, (*iii*) design and prototyping, (*iv*) software development, (*v*) testing, (*vi*) deployment, and (*vii*) maintenance and updates. The average software development lead time is 45 days, and each team has six members (on average) working on the same project supervised by a manager. Problems may occur indistinctly in any of these activities and, depending on their criticality and complexity, can be either addressed by team members or escalated to project manager and other organizational levels. In terms of interviewees, we involved two software developers (operational level), customer management analyst (tactical level), and two project managers (strategic level).

Concerning the support of social media to problem-solving activities, interviewees mentioned that, although it has been quite useful for communication and escalation of problems, problem resolution and knowledge sharing activities have been more benefitted from it. Such aspect has been particularly evidenced at the operational level (software developers), as explained by B4:

> "*Once a problem is identified and I do not know how to address it, I usually share the issue with other software developers through a group we have in Slack. Most of the times, somebody in the group has already faced that situation and knows how to curb it. In this sense, I do not waste time trying to devise something or escalating the problem to other people.*"

However, due to the informality with which problems are discussed in social media, the standardization of solutions is not always verified, undermining the systemic improvement of the value stream and solely relying on the tacit knowledge of employees who are actually involved in that particular Slack group. Such issue has been emphasized by B1:

> "*Social media has helped increase the flow of information among people. However, if not structured, such an increase tends to become just random, without generating systemic benefits to the software development process. I believe we still need to organize the flow of information at the social media, so that we can truly benefit from the from the dynamism it provides.*"

The ill-structured flow of information through social media is also likely to affect problem-solving activities in terms of its quality and manner, as the ideas and situations described may not be fully understood. This can even mislead problem resolution by fostering a narrow solution or encouraging a wasteful unstructured "trial-and-error" approach. This was highlighted by B5:

> "*Sometimes, people do not fully understand the problem or just share part of it via social media. As a result, people in the group tend to suggest countermeasures that are not necessarily right for the problem, leading to a waste of efforts.*"

4.3. Case study C

Case study C was conducted in the emergency room of a large-sized public teaching hospital in Brazil. Although not systemically, this hospital has been implementing LP practices for fourteen years, with a particular focus on some highly complex departments, such as surgery room and emergency room. Besides some traditional LP practices, such as 5S, visual management, *kanban* (for consumables), and standardized work, the hospital has widely adopted the HC, whose design was properly customized to address problems of each department. The emergency room has 96 members (e.g., technicians, nurses, physicians, administrative staff, etc.) divided into four shifts, and treats in average 143 new patients every day in addition to the ones that remain in treatment (average length-of-stay of 5.2 days). After the emergency treatment, patients are either forwarded to another department of the hospital of released to go to their homes. Regarding the interviewees, two technicians (operational level), one nurse and one physician (tactical level), and the emergency room manager (strategic level) were involved in the study.

Because of the variety of treatments encompassed in the emergency room, problems' complexity may significantly vary, becoming an even more challenging environment. However, the designed procedures for

problem-solving activities should be similar in most cases, triggering the HC and escalating problems whenever needed. When a problem occurs, it can be identified by the patient, who pushes the button requesting for help, or via audible alarms built into the equipment that holds patients. The nursing technician is always the first one supposed to offer help. For that, he/she follows a standard procedure that encompasses some basic checks. If the problem remains after this check, the nurse responsible for that area and shift is called and the problem is escalated. The nurse performs a complementary and more complex set of standardized checks towards the solution of the problem. If this is not enough, a physician is contacted to support, customizing the treatment according to the patient's needs. Problems that require physicians' support and took more than 30 min are registered and, later, analyzed more in-depth by the group of physicians from the emergency room. The objective of this *post hoc* analysis is to identify how the current standardized procedures can be strengthened to address such type of problems, hence, improving the HC.

Five years ago, the hospital has purchased a version of the Facebook Messenger to support the internal communication of the hospital. Although this social media was not specifically introduced to support the HC, it has also been used to facilitate problem-solving activities within and across departments. Team members at the operational and tactical levels have mostly benefitted from it, as they present a more frequent use of it. This utilization has been more evident in terms of problems communication and escalation, despite some existing challenges related to redundancies in the communication channels, as stated by C3:

> "*The use of social media has been an effective way of communicating problems and asking for help, whether from employees in the same department or from others. However, I must say that its adoption has not avoided the utilization of other communication channels, such as telephone and e-mails. This sometimes creates confusion since there is no single and standardized way for communicating problems.*"

Another aspect particularly emphasized by C1 and C2 is the benefit of social media as a way of registering problems that occurred in a given work shift and were not yet resolved so that the subsequent work shift knows what to focus on. Both interviewees mentioned that they usually write in an existing group of the Facebook Messenger at the end of their shift a brief report about the critical issues that deserve attention from the next shift. This highlights the priorities that must be addressed by the next shift, assuring and facilitating the resolution of those problems. However, it is worth noting that this initiative seems to happen in parallel with other existing systems in the hospital, falling again on the issue of information redundancy.

In terms of the impact of social media, different effects were observed. The amount of shared information related to problem-solving activities has notably increased, to the point of evident redundancies, as already mentioned. Regarding the quality of information, although it did not appear to be a critical issue, none of the evidence indicated that it has been either improved or worsened due to social media adoption. Nevertheless, the relation and manner of information seem to be often undermined by the social media utilization, since the information sharing tends to be less formal than what is expected in the other existing systems of the hospital (e.g., the software used for managing business processes, data and information flow across the hospital), resulting in lack of relevant details for an effective problem-solving. This may also overburden certain levels of the HC (e.g., nurses and physicians), as they need to double-check the shared information, wasting time and efforts to assure their understanding of the problem, as informed by C4 and C5.

4.4. In-case and cross-case analysis

Table 4 consolidates the results related to the extent of social media adoption in problem-solving activities. We consolidated the findings in each studied case and across cases based on the evidence collected via semi-structured interviews, in loco visits, and secondary data.

Table 4
Extent of social media adoption in problem-solving activities.

Problem-solving activities	Case study A	Case study B	Case study C	Cross-case analysis
Problems identification and registration	Not explicitly evidenced	Briefly evidenced	Briefly evidenced	Briefly evidenced
Problems communication and escalation	Highly evidenced	Highly evidenced	Highly evidenced	Highly evidenced
Problems resolution	Briefly evidenced	Briefly evidenced	Briefly evidenced	Briefly evidenced
Solution standardization and learning	Not explicitly evidenced	Not explicitly evidenced	Not explicitly evidenced	Not explicitly evidenced

First, regarding problems identification and registration, we briefly evidenced the adoption of social media in *case studies B and C*. No explicit evidence was found in *case study A*. While in *case study B* the emphasis of social media was more related to identifying problems in the analyzed value stream, in *case study C* social media adoption seemed to be more advantageous for problems registration. However, in both cases social media has been used as a redundancy for such problem-solving activities, since the organizations already presented a formal system to do so. Hence, the practice of identifying and registering problems via social media was not really standardized, which made its use quite random among the team members. Based on these arguments, we posed that social media adoption for problems identification and registration was briefly evidenced in the cross-case analysis.

Social media adoption for problems communication and escalation has been emphatically mentioned in all case studies. The collected data suggested that social media has been extensively used to communicate problems and request support, bridging the information between individuals from the same of different levels of the HCs. It is also worth mentioning that the procedures for communicating and escalating problems via social media still lacked standardization, as observed in *case studies B and C*. Despite these issues and improvement opportunities, social media adoption for problems communication and escalation was highly evidenced across cases.

With respect to problems resolution, the three lean organizations appeared to be utilizing social media as a means to share the difficulties when resolving problems, especially among employees of the same level of the HC. As observed in *case study B*, when an employee faced a problem whose solution he was not entirely confident about, he/she used social media to ask for suggestions from other employees of the same level in the HC, expecting that their experience could be useful for resolving that particular problem. This favored problem resolution, since it became not solely based on the individual's knowledge, but on the group's combined experience. Nevertheless, this practice was still very informal and ill-structured in the lean organizations, not being extensively adopted and neither yielding its full benefits. Thus, the cross-case analysis indicated that social media adoption for problems resolution was briefly evidenced.

Finally, the analysis of the case studies suggested that social media's support for solution standardization and learning appeared to be the least evidenced one. None of the examined lean organizations have explicitly embedded the information shared through social media into their learning processes. Although individuals' skills and knowledge may improve through the adoption of social media in the previous problem-solving activities, such an increase is quite marginal as it mostly relies on the individuals' initiative to standardize and systematically disseminate the obtained knowledge. Therefore, due to the lack of evidence in the studied HCs, we claimed that social media adoption for solution standardization and learning was not explicitly evidenced.

5. Discussion and propositions

Identifying commonalities among case studies allowed us to discuss and formulate general propositions for further theory testing and validation. Although social media adoption was differently evidenced in each problem-solving activity, its impact (e.g., positive or negative) may also vary. Based on the evidence collected from multiple sources in the case studies, Table 5 synthesizes the impact of social media adoption on problem-solving activities in lean organizations according to the four conversational maxims of the IMT. We now discuss the briefly and highly evidenced associations.

With regards to the quantity of information, our findings suggested that social media adoption has significantly increased the amount of information shared throughout the HCs. Such indication is coherent with the findings from Li et al. [16] and Koehler et al. [15], which claimed that collaborative problem-solving practices may emerge through the open and constant communication facilitated by social media. This positive impact was highly observed in problems communication and escalation, which tend to benefit from a faster access to abundant information [103]. A similar, less prominent impact was also evidenced for problem resolution. In lean organizations, one of the first steps to effective problem resolution is the accessibility and collection of data and facts that help understand the problem *status quo* [6,38]. Social media appears to work as an enabler for increasing the amount of shared data and facts, regardless of their relevance for the problem resolution. Therefore, when we specifically consider the quantity of information resulting from social media adoption in problem-solving activities in lean organizations, the following proposition arises:

Proposition 1. *The adoption of social media as a supporting tool for problem-solving in lean organizations positively impacts the quantity of information, particularly for problems communication and escalation, and problems resolution.*

However, when the quality of information is considered, our investigation suggested that adopting social media does not necessarily result in more accurate information, despite the increased quantity shared in the HCs. In fact, interviewees mentioned that because the details of the problems may be often poorly shared, they usually dedicate additional efforts to verify whether the data and facts are valid before beginning to resolve problems. This wasted efforts and time can be seen as an over-processing of information since it is an extra step that adds cost but not value [28,3]. Such negative impact was mainly observed for problems communication and escalation, and problems resolution. The issue related to the veracity and accuracy of information shared on social media has been widely discussed in various fields of knowledge (e.g., [104–106]). Overall, there seems to be a consensus that one of the main risks associated with an extensive use of social media corresponds to whether the information given is truthful and correct. Our results suggested that such an issue may also exist in problem-solving activities in lean organizations, especially in the communication, escalation, and resolution of problems. Therefore, to examine this association, we formulate the following proposition:

Proposition 2. *The adoption of social media as a supporting tool for problem-solving in lean organizations negatively impacts the quality of information, particularly for problems communication and escalation, and problems resolution.*

Relation of information represents how relevant the information is to the subject matter of the conversation in hand [21]. When focusing on this IMT dimension, two problem-solving activities seemed to be more impacted by social media adoption: (*i*) problems communication and escalation, and (*ii*) problems resolution. In both cases, the collected evidence suggested a negative impact of social media. The utilization of groups of conversation is a common practice to facilitate communication in social media. Such groups are usually formed due to affinities and common interests. As organizations increase their utilization, overlaps (both in terms of individuals and purposes) among groups may occur [107,108], yielding ambiguity and gaps in the information. This may also imply doubts and misguiding indications among individuals, generating irrelevant information to the problem under investigation. Spear [29] and Tortorella et al. [32] emphasized that a key reason why lean organizations usually present a high problem-solving capability is the fact that the information should be unequivocal, with standardized routes and connections throughout processes. In opposition, social media may foster a fuzzy, scattered, and ill-structured way of diffusing the information [109,110], hence, compromising a more agile communication and resolution of problems. To better check these arguments, we raise the following proposition:

Proposition 3. *The adoption of social media as a supporting tool for problem-solving in lean organizations negatively impacts the relation of information, particularly for problems communication and escalation, and problems resolution.*

For the manner of information, our results indicated two different impacts of social media adoption in problem-solving activities. On one hand, we briefly evidenced that social media has been used to support problems identification and registration, offering an easier and more assertive communication channel than the existing formal systems in the studied organizations. As emphasized by Bakshy et al. [111] and Van Rooyen [112], the simplicity and ease of use of social media tend to make the information more straightforward, being an interesting alternative to complex organizational information systems that require the fulfillment of several fields and usually take a longer time to be done. In this sense, the utilization of social media to register problems seems to be more appealing and pervasive, as team members can easily input their information and identify critical problems to be solved. On the other hand, social media adoption in problem-solving activities may still occur in a disorganized and random way, even in organizations with established HCs. This fact implies that a significant part of the shared information may not be easily understood by the social media users, corroborating to McGowan et al. [113] and Tajudeen et al. [114]. This impact was specifically observed for problems resolution, as HC individuals often needed to perform some kind of workaround on the shared information to properly understand what the problem was and move to the resolution. To verify these conflicting arguments, we formulate the following propositions:

Proposition 4. *The adoption of social media as a supporting tool for problem-solving in lean organizations positively impacts the manner of information, particularly for problems identification and registration.*

Proposition 5. *The adoption of social media as a supporting tool for*

Table 5
Impact of social media adoption on problem solving activities in terms of IMT's dimensions.

Problem-solving activities	Quantity of information	Quality of information	Relation of information	Manner of information
Problems identification and registration	+	+	+	++
Problems communication and escalation	+++	- - -	- - -	–
Problems resolution	++	- -	- -	- -
Solution standardization and learning	+	–	–	–

Note: '+' positive impact not explicitly evidenced; '++' positive impact briefly evidenced; '+++' positive impact highly evidenced; '-' negative impact not explicitly evidenced; '- -' negative impact briefly evidenced; and '- - -' negative impact highly evidenced.

problem-solving in lean organizations negatively impacts the manner of information, particularly for problems resolution.

Finally, it worth highlighting that we did not find any briefly or highly evidenced association that involved solution standardization and learning. This unexpected outcome suggests that the adoption social media may not be suitable for standardizing procedures and solutions of problems, neither supporting a systematic learning process in the organization. Bretschneider and Parker [115] and Hatzithomas et al. [116] argued that the informality of language and discourse inherent to social media tend to impair the development and utilization of more concise and rigid procedures. Such an argument is somewhat aligned with the poor evidence found for the use of social media to support this type of problem-solving activity. Thus, no propositions were formulated encompassing the impact of social media on solution standardization and learning. However, further evidence should be raised to more confidently verify this association.

6. Conclusions

This study examined the impact of social media adoption on problem-solving activities in organizations undergoing a LP implementation. Utilizing an inductive rationale, we investigated multiple sources of evidence from three organizations from different sectors, allowing us to identify commonalities and formulate five general propositions for future empirical verification and validation. Our study presents insightful findings relevant for both theory and practice in the field.

From a theoretical standpoint, the utilization of the IMT concepts and dimensions has been useful to frame and better understand the associations between social media and problem-solving activities in lean organizations. Our findings indicate that, while social media may favor the amount of information being shared, the relevance and the level of details of such information may be low, overburdening the HC mechanisms and generating wastes in the organizations like overprocessing. Moreover, identifying the impact of social media on problem-solving activities allows a better comprehension of how new information and communication technologies, such as social media, can foster (or impair) the intra- and inter-organizational links towards a more effective and efficient LP implementation. To the best of our knowledge, no similar research has been conducted on this topic. Thus, we argue that this is an original contribution of our study.

In practical terms, our study provided managers arguments to improve social media integration into problem-solving routines, such as the HC. Such arguments can function as inputs to enhance the problem-solving capabilities, resulting in a more responsive organization. In addition, the identification of the impact on problem-solving activities allows the establishment of adequate organizational expectations with regards to social media adoption. Thus, organizations undergoing a LP implementation may be able to reinforce the positive associations and anticipate challenges in its adoption, refining their HC and intrinsic problem-solving routines accordingly. This can avoid the waste of managerial efforts and yield competitive advantages in the long term.

Some limitations of this study must be emphasized. First, being a qualitative study, the indicated associations were not statistically nor numerically verified. Although we performed all the recommended countermeasures to avoid bias in our data collection and analysis, these associations emerged from the investigation of three different organizations. To allow a broader generalization of the indications, future studies should encompass a larger and more diversified set of organizations that enables the utilization of sophisticated multivariate data analysis techniques. This would possibly yield the validation of causal relationships between the studied variables. Second, the poor evidence found for the association between social media adoption and solution standardization and learning may be seen as a limitation of the researched case studies. Further studies should collect more evidence about this relationship and compare it with our findings to raise more compelling arguments.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jii.2023.100515.

References

[1] P. Hasle, A. Bojesen, P.L. Jensen, P. Bramming, Lean and the working environment: a review of the literature, Int. J. Operat. Product. Manage. 32 (7) (2012) 829–849.
[2] N.V.K. Jasti, R. Kodali, Lean Production: literature review and trends, Int. J. Prod. Res. 53 (3) (2015) 867–885.
[3] J. Womack, D. Jones, Lean thinking—banish waste and create wealth in your corporation, J. Oper. Res. Soc. 48 (11) (1997) 1148.
[4] S. Spear, Learning to lead at Toyota, Harv. Bus. Rev. 82 (5) (2004) 78–91.
[5] S. Spear, H.K. Bowen, Decoding the DNA of the Toyota production system, Harv. Bus. Rev. 77 (1999) 96–108.
[6] J.K. Liker, Toyota way: 14 Management Principles from the World's Greatest Manufacturer, McGraw-Hill Education, New York, 2004.
[7] D. Powell, E. Reke, No lean without learning: rethinking Lean Production as a learning system, in: IFIP International Conference on Advances in Production Management Systems, Springer, Cham, 2019, pp. 62–68.
[8] J.R. Jadhav, S.S. Mantha, S.B. Rane, Analysis of interactions among the barriers to JIT production: interpretive structural modelling approach, J. Industr. Eng. Int. 11 (3) (2015) 331–352.
[9] E. Berk, A. Toy, Quality control chart design under Jidoka, Nav. Res. Logist. 56 (5) (2009) 465–477.
[10] J.K. Liker, D. Meier, Toyota Talent, McGraw-Hill, New York, 2007.
[11] G. Tortorella, D. Fettermann, Help chain in companies undergoing a lean implementation: the impact of critical success factors on quality and efficiency performance, Int. J. Lean Six Sigma 9 (1) (2018) 113–132.
[12] Y.A. Ahmed, M.N. Ahmad, N. Ahmad, N.H. Zakaria, Social media for knowledge-sharing: a systematic literature review, Telemat. Inform. 37 (2019) 72–112.
[13] J.P. Hansen, L.M. Jespersen, A.L. Jensen, K. Holst, C. Mathiesen, G. Brunori, I. A. Rasmussen, ICT and social media as drivers of multi-actor innovation in agriculture, CIGR Proceed. 1 (1) (2014).
[14] N. Munthali, A. Van Paassen, C. Leeuwis, R. Lie, R. van Lammeren, N. Aguilar-Gallegos, B. Oppong-Mensah, Social media platforms, open communication and problem solving in the back-office of Ghanaian extension: a substantive, structural and relational analysis, Agric. Syst. 190 (2021), 103123.
[15] A.A. Koehler, D.R. Vilarinho-Pereira, Using social media affordances to support Ill-structured problem-solving skills: considering possibilities and challenges, Educat. Technol. Res. Develop. (2021) 1–37.
[16] K. Li, L. Huang, Z. Song, Understanding the emergence of collaborative problem-solving practices in enterprise social media: the roles of social factors, IEEE Access 8 (2020) 210066–210080.
[17] S. Sin, Social media and problematic everyday life information-seeking outcomes: differences across use frequency, gender, and problem-solving styles, J. Assoc. Inf. Sci. Technol. 67 (8) (2016) 1793–1807.
[18] M. Janssen, E. Estevez, Lean government and platform-based governance—doing more with less, Gov. Inf. Q. 30 (2013) S1–S8.
[19] A. Meissner, M. Müller, A. Hermann, J. Metternich, Digitalization as a catalyst for Lean Production: a learning factory approach for digital shop floor management, Procedia Manuf. 23 (2018) 81–86.
[20] A. Potter, Exploring the role of lean managers within the Toyota supply network: evidence from a social media platform, Product. Plan. Control 33 (8) (2022) 723–740.
[21] S.A. McCornack, Information manipulation theory, Commun. Monogr. 59 (1992) 1–16.
[22] S.A. McCornack, T.R. Levine, K. Solowczuk, H. Torres, D. Campbell, When the alteration of information is viewed as deception: an empirical test of information manipulation theory, Commun. Monogr. 59 (1992) 17–29.
[23] S.A. McCornack, T.R. Levine, K. Morrison, M. Lapinski, Speaking of information manipulation: a critical rejoinder, Commun. Monogr. 63 (1996) 83–92.

[24] S.A. McCornack, K. Morrison, J.E. Paik, A.M. Wisner, X. Zhu, Information manipulation theory 2: a propositional theory of deceptive discourse production, J. Lang. Soc. Psychol. 33 (4) (2014) 348–377.
[25] M. Keil, G. Depledge, A. Rai, Escalation: the role of problem recognition and cognitive bias, Decis. Sci. 38 (3) (2007) 391–421.
[26] L.F. Lages, A. Ricard, A. Hemonnet-Goujot, A.M. Guerin, Frameworks for innovation, collaboration, and change: value creation wheel, design thinking, creative problem-solving, and lean, Strategic Change 29 (2) (2020) 195–213.
[27] I. Lasa, R. Castro, C. Laburu, Extent of the use of Lean concepts proposed for a value stream mapping application, Product. Plan. Control 20 (1) (2009) 82–98.
[28] Womack, J. (2009). *The mind of lean manager*. Available at: <www.lean.org>. (accessed 01 october 2013).
[29] S. Spear, Chasing the Rabbit: How Market Leaders Outdistance the Competition and How Great Companies Can Catch Up and Win, MacGraw-Hill, New York, 2009.
[30] P. Puvanasvaran, H. Megar, T. Hong, M. Razali, The roles of communication process for an effective lean manufacturing implementation, J. Industr.Eng. Manage. 2 (1) (2009) 128–152.
[31] G. Tortorella, D. Fettermann, P. Cauchick Miguel, R. Sawhney, Learning organisation and Lean Production: an empirical research on their relationship, Int. J. Prod. Res. 58 (12) (2020) 3650–3666.
[32] G. Tortorella, S. Viana, D. Fettermann, Learning cycles and focus groups, The Learn. Org. 22 (4) (2015) 229–240.
[33] M. Baudin, *Working with Machines: the Nuts and Bolts of Lean Operations with Jidoka*, Productivity Press, New York, 2007.
[34] S. Vinodh, D. Joy, Structural equation modelling of lean manufacturing practices, Int. J. Prod. Res. 50 (6) (2012) 1598–1607.
[35] G. Marodin, T. Saurin, Classification and relationships between risks that affect Lean Production implementation: a study in Southern Brazil, J. Manuf. Technol. Manage. 26 (1) (2015) 57–79.
[36] Kamada, S. (2008). *A cadeia de ajuda para manter a estabilidade produtiva*. Lean institute Brasil. Available at: www.lean.org.br (accessed on November 29th 2022).
[37] J.M. Worley, T.L. Doolen, Organizational structure, employee problem solving, and lean implementation, Int. J. Lean Six Sigma 6 (1) (2015) 39–58.
[38] J. Shook, Managing to Learn: Using the A3 Management Process to Solve Problems, Gain Agreement, Mentor and Lead, Lean Enterprise Institute, New York, 2008.
[39] T. Richardson, E. Richardson, The Toyota Engagement Equation: How to Understand and Implement Continuous Improvement Thinking in any Organization, McGraw Hill, New York, NY, 2017.
[40] T.H. Netland, D. Powell, P. Hines, Demystifying lean leadership, Int. J. Lean Six Sigma 11 (3) (2019) 543–554.
[41] J.K. Liker, M. Hoseus, Toyota Culture: The Heart and Soul of the Toyota Way, McGraw-Hill, New York, 2008.
[42] M.L. Huo, P. Boxall, Are all aspects of Lean Production bad for workers? An analysis of how problem-solving demands affect employee well-being, Hum. Resour. Manage. J. 28 (4) (2018) 569–584.
[43] M.V. Iuga, L.I. Rosca, Comparison of problem solving tools in lean organizations, in: MATEC web of conferences 121, EDP Sciences, 2017, p. 02004.
[44] D.J. Powell, P. Coughlan, Corporate lean programs: practical insights and implications for learning and continuous improvement, Procedia CIRP 93 (2020) (2020) 820–825.
[45] M. Ballé, N. Chartier, P. Coignet, S. Olivencia, D. Powell, E. Reke, The Lean Sensei. Go, See, Challenge, The Lean Enterprise Institute Inc., Boston, 2019.
[46] M. Rother, Toyota Kata: Managing People for Improvement, Adaptiveness and Superior Results, McGraw-Hill Professional, New York, 2009.
[47] J.L. Jimenez-Marquez, I. Gonzalez-Carrasco, J.L. Lopez-Cuadrado, B. Ruiz-Mezcua, Towards a big data framework for analyzing social media content, Int. J. Inf. Manage. 44 (2019) 1–12.
[48] P.M. Leonardi, M. Huysman, C. Steinfield, Enterprise social media: definition, history, and prospects for the study of social technologies in organizations, J. Comput. Mediat. Commun. 19 (1) (2013) 1–19.
[49] Ortiz-Ospina, E., & Roser, M. (2023). The rise of social media. *Our world in data*. Available at: https://ourworldindata.org/rise-of-social-media (accessed on June 27th 2023).
[50] V. Scuotto, G. Santoro, S. Bresciani, M. Del Giudice, Shifting intra-and inter-organizational innovation processes towards digital business: an empirical analysis of SMEs, Creat. Innov. Manage. 26 (3) (2017) 247–255.
[51] H. Bhimani, A.L. Mention, P.J. Barlatier, Social media and innovation: a systematic literature review and future research directions, Technol. Forecast. Soc. Change 144 (2019) 251–269.
[52] C. Greenhow, S.M. Galvin, K.B. Staudt Willet, What should be the role of social media in education? Pol. Insights Behav. Brain Sci. 6 (2) (2019) 178–185.
[53] M. Mount, M.G. Martinez, Social media: a tool for open innovation, Calif. Manage. Rev. 56 (4) (2014) 124–143.
[54] T.M. Nisar, G. Prabhakar, L. Strakova, Social media information benefits, knowledge management and smart organizations, J. Bus. Res. 94 (2019) 264–272.
[55] D. Palacios-Marqués, J.M. Merigó, P. Soto-Acosta, Online social networks as an enabler of innovation in organizations, Manage. Decis. 53 (9) (2015) 1906–1920.
[56] I.J. Orji, S. Kusi-Sarpong, H. Gupta, The critical success factors of using social media for supply chain social sustainability in the freight logistics industry, Int. J. Prod. Res. 58 (5) (2020) 1522–1539.
[57] D.L. Roberts, F.T. Piller, D. Lüttgens, Mapping the impact of social media for innovation: the role of social media in explaining innovation performance in the PDMA comparative performance assessment study, J. Prod. Innov. Manage. 33 (2016) 117–135.
[58] X. Chen, S. Wei, The impact of social media use for communication and social exchange relationship on employee performance, J. Knowl. Manage. 24 (6) (2020) 1289–1314.
[59] C. Jewpanich, P. Piriyasurawong, Project-based learning using discussion and lesson-learned methods via social media model for enhancing problem solving skills, Int. Educat. Stud. 8 (6) (2015) 24–31.
[60] J. Lee, Y. Koo, M.H. Kim, Enhancing problem solving skills in science education with social media and an e-collaboration tool, The New Educat. Rev. 43 (2016) 248–259.
[61] A. Panaoura, Parental involvement in developing students' perseverance in solving mathematical problem through the use of social media, Int. J. Technol. Educ. Sci. 1 (1) (2017) 36–47.
[62] G.C. Kane, D. Palmer, A.N. Phillips, D. Kiron, N. Buckley, Moving beyond marketing: generating social business value across the enterprise, MIT Sloan Manage. Rev. 56 (1) (2014) 1–27.
[63] A. Ali, W. Bahadur, N. Wang, A. Luqman, A.N. Khan, Improving team innovation performance: role of social media and team knowledge management capabilities, Technol. Soc. 61 (2020), 101259.
[64] J. Yang, P. Xiu, L. Sun, L. Ying, B. Muthu, Social media data analytics for business decision making system to competitive analysis, Inf. Process Manag. 59 (1) (2022), 102751.
[65] T. Diviák, Key aspects of covert networks data collection: problems, challenges, and opportunities, Soc. Netw. 69 (2022) 160–169.
[66] N. Obermayer, E. Kővári, J. Leinonen, G. Bak, M. Valeri, How social media practices shape family business performance: the wine industry case study, Eur. Manage. J. 40 (3) (2022) 360–371.
[67] A. Adikari, D. Burnett, D. Sedera, D. De Silva, D. Alahakoon, Value co-creation for open innovation: an evidence-based study of the data driven paradigm of social media using machine learning, Int. *J. Inform. Manage. Data Insights* 1 (2) (2021), 100022.
[68] L. Xie, J. Pinto, B. Zhong, Building community resilience on social media to help recover from the COVID-19 pandemic, Comput. Hum. Behav. 134 (2022), 107294.
[69] S. Goode, Exploring organizational information sharing in adopters and non-adopters of open source software: evidence from six case studies, Knowl. Process Manage. 21 (1) (2014) 78–89.
[70] S.A. McCornack, The logic of lying: a rational approach to the production of decept messages, in: Proceedings of the *Annual Meeting of the Speech Communication Association*, New Orleans, LA, 1988.
[71] S.A. McCornack, Incrementality, intentionality, and information manipulation: moving beyond the truth/lie myth, in: Presented at the *Annual Meeting of the Association for Psychological Science*, Chicago, 2022.
[72] L.N.T. Yeung, T.R. Levine, K. Nishiyama, Information manipulation theory and perceptions of deception in Hong Kong, Commun. Rep. 12 (1) (1999) 1–11.
[73] T. Levine, K. Asada, L. Lindsey, The relative impact of violation type and lie severity on judgments of message deceitfulness, Commun. Res. Rep. 20 (3) (2003) 208–218.
[74] L. Zhou, S. Lutterbie, Deception across cultures: bottom-up and top-down approaches, in: Presented at *IEEE International Conference on Intelligence and Security Informatics*, Atlanta, GA, 2005.
[75] M. Barratt, T. Choi, M. Li, Qualitative case studies in operations management: trends, research outcomes, and future research implications, J. Oper. Manage. 29 (4) (2011) 329–342.
[76] C. Voss, N. Tsikriktsis, M. Frohlich, Case research in operations management, Int. J. Oper. Product. Manage. 22 (2) (2002) 195–219.
[77] M. Ketokivi, T. Choi, Renaissance of case research as a scientific method, J. Oper. Manage. 32 (5) (2014) 232–240.
[78] R. Yin, Case Study Research: Design and Methods, Sage, London, 2012.
[79] E. Wikfeldt, Generalising from Case Studies, Halmstad University, 2016. Available at: http://hh.diva-portal.org/smash/get/diva2:1051446/FULLTEXT01.pdf (accessed on May 2nd 2021).
[80] R. Yin, Validity and generalization in future case study evaluations, Evaluation 19 (3) (2013) 321–332.
[81] A. Erthal, L. Marques, National culture and organisational culture in lean organisations: a systematic review, Prod. Plan. Control 29 (8) (2018) 668–687.
[82] P.B. Smith, Communication styles as dimensions of national culture, J. Cross Cult. Psychol. 42 (2) (2011) 216–233.
[83] L. Furstenau, M. Sott, A. Homrich, L. Kipper, M. Dohan, J. López-Robles, M. Cobo, G. Tortorella, An overview of 42 years of Lean Production: applying bibliometric analysis to investigate strategic themes and scientific evolution structure, Technol. Anal. Strategic Manage. 33 (9) (2021) 1068–1087.
[84] G. Marodin, A. Frank, G. Tortorella, D. Fetterman, Lean Production and operational performance in the Brazilian automotive supply chain, Total Qual. Manage. Bus. Excel. 30 (3–4) (2019) 370–385.
[85] G. Cardoso, T. Lapa, B. Di Fatima, People are the message? Social mobilization and social media in Brazil, Tetrahedron Lett. 10 (2016) 22.
[86] J. Spyer, Social Media in Emergent Brazil, UCL Press, 2017, p. 258.
[87] E. Obilor, Convenience and purposive sampling techniques: are they the same, Int. J. Innov. Soc. Sci. Educ. Res. 11 (1) (2023) 1–7.
[88] G. Tortorella, G. Silva, L. Campos, C. Pizzeta, A. Latosinski, A. Soares, Productivity improvement in solid waste recycling centres through lean implementation aided by multi-criteria decision analysis, Benchmarking: An Int. J. 25 (5) (2018) 1480–1499.

[89] G. Guest, E. Namey, J. Taylor, N. Eley, K. McKenna, Comparing focus groups and individual interviews: findings from a randomized study, Int. J. Soc. Res. Methodol. 20 (6) (2017) 693–708.
[90] L. Dubé, G. Paré, Rigor in information systems positivist case research: current practices, trends and recommendations, MIS Q. 27 (4) (2003) 597–635.
[91] J. Corbin, A. Strauss, Basics of Qualitative Research, Sage, London, 2008.
[92] M. Miles, M. Huberman, Qualitative Data analysis: An Expanded Sourcebook, Sage Publishing, Thousand Oaks, 1994.
[93] P. Mayring, Qualitative content analysis, A Compan. Qual. Res. 1 (2) (2004) 159–176.
[94] E. Bell, A. Bryman, B. Harley, Business Research Methods, Oxford University Press, London, 2018.
[95] M. White, E. Marsh, Content analysis: a flexible methodology, Libr. Trends 55 (1) (2006) 22–45.
[96] H. Hsieh, S. Shannon, Three approaches to qualitative content analysis, Qual. Health Res. 15 (9) (2005) 1277–1288.
[97] N. Alemsan, G. Tortorella, C. Rodriguez, H. Jamkhaneh, R. Lima, Lean and resilience in the healthcare supply chain–a scoping review, Int. J. Lean Six Sigma (2022) (forthcoming).
[98] A. Hussein, The use of triangulation in social sciences research: can qualitative and quantitative methods be combined? J. Comparat. Soc. Work 1 (1) (2015) 1–12.
[99] N. Carter, D. Bryant-Lukosius, A. DiCenso, J. Blythe, A. Neville, The use of triangulation in qualitative research, Oncol. Nurs. Forum 41 (5) (2014).
[100] R. Narasimhan, Theory development in operations management: extending the frontiers of a mature discipline via qualitative research, Decis. Sci. 45 (2) (2014) 209–227.
[101] G. Tortorella, F. Fogliatto, P. Cauchick-Miguel, S. Kurnia, D. Jurburg, Integration of Industry 4.0 technologies into total productive maintenance practices, Int. J. Prod. Econ. 240 (2021), 108224.
[102] J. Gray, A. Reuter, Transaction Processing: Concepts and Techniques, Elsevier, New York, 1992.
[103] A.S. Hayek, C. Toma, D. Oberlé, F. Butera, Grading hampers cooperative information sharing in group problem solving, Soc. Psychol. 46 (3) (2015) 121.
[104] H. Li, Y. Sakamoto, Social impacts in social media: an examination of perceived truthfulness and sharing of information, Comput. Hum. Behav. 41 (2014) 278–287.
[105] E.K. Vraga, M. Tully, News literacy, social media behaviors, and skepticism toward information on social media, Infor., Commun. Soc. 24 (2) (2021) 150–166.
[106] X. Zha, H. Yang, Y. Yan, K. Liu, C. Huang, Exploring the effect of social media information quality, source credibility and reputation on informational fit-to-task: moderating role of focused immersion, Comput. Hum. Behav. 79 (2018) 227–237.
[107] D.J. Power, G. Phillips-Wren, Impact of social media and Web 2.0 on decision-making, J. Decis. Syst. 20 (3) (2011) 249–261.
[108] X. Wang, L. Tang, H. Gao, H. Liu, Discovering overlapping groups in social media, in: 2010 IEEE International Conference on Data Mining, IEEE, 2010, pp. 569–578.
[109] Z. Qiang, E. Pasiliao, Q. Zheng, Model-based learning of information diffusion in social media networks, Appl. Netw. Sci. 4 (1) (2019) 1–16.
[110] F. Xiong, Y. Liu, Z. Zhang, J. Zhu, Y. Zhang, An information diffusion model based on retweeting mechanism for online social media, Phys. Lett. A 376 (30–31) (2012) 2103–2108.
[111] E. Bakshy, I. Rosenn, C. Marlow, L. Adamic, The role of social networks in information diffusion, in: Proceedings of the 21st international conference on World Wide Web, 2012, pp. 519–528.
[112] A. Van Rooyen, Social media is so easy to share, Account. Educ. 29 (4) (2020) 356–371.
[113] B.S. McGowan, M. Wasko, B.S. Vartabedian, R.S. Miller, D.D. Freiherr, M. Abdolrasulnia, Understanding the factors that influence the adoption and meaningful use of social media by physicians to share medical information, J. Med. Internet Res. 14 (5) (2012) e2138.
[114] F.P. Tajudeen, N.I. Jaafar, S. Ainin, Understanding the impact of social media usage among organizations, Infor. Manage. 55 (3) (2018) 308–321.
[115] S. Bretschneider, M. Parker, Organization formalization, sector and social media: does increased standardization of policy broaden and deepen social media use in organizations? Gov. Inf. Q. 33 (4) (2016) 614–628.
[116] L. Hatzithomas, T.A. Fotiadis, D.N. Coudounaris, Standardization, adaptation, and personalization of international corporate social media communications, Psychol. Market. 33 (12) (2016) 1098–1105.