Pandemic's effect on the relationship between lean implementation and services performance

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Abstract

Purpose - This paper aims at examining the impact that COVID-19 pandemic and its related work implications have on the relationship between lean implementation and services performance.

Design/methodology/approach - We surveyed service organizations that have been implementing lean for at least two years, and remotely maintained their activities during the COVID-19 outbreak. Multivariate data techniques were applied to analyze the dataset. This study was grounded on socio-technical systems theory.

Findings - Our findings indicate that organizations that have been implementing lean services more extensively are also more likely to benefit from the effects that the COVID-19 had on work environments, especially in the case of home office. Nevertheless, social distancing does not appear to mediate the effects of lean services on both quality and delivery performances.

Originality/value - Since the pandemic is a recent phenomenon with unprecedented effects, our research is an initial effort to determine the effect the pandemic has on lean implementation and services' performance, providing both theoretical and practical contributions to the field.

Keywords: Service organizations, Lean services, COVID-19, Performance.

1. Introduction

With the worldwide outbreak of a new coronavirus infection (COVID-19), the health of individuals, organizations and economies has been significantly impacted. From a supply chain perspective, several organizations have faced disruptions either in terms of material, equipment, personnel or information (Ivanov and Dolgui, 2020). Although such disruptions may vary, they are generally represented by (*i*) weakening demand for some companies while increasing it for others, (*ii*) uncertainty in obtaining raw materials, (*iii*) affecting the ability to ship and receive products on time due to shortages and logistics bottlenecks, and (*iv*) disrupting workforce capacity to assemble and ship products (Zanni, 2020). Facing this scenario, governments around the world

have been preparing contingency plans, and aid packages to sustain their economies (Ivanov, 2020), with implications that have differed depending on the industry sector (Guglielmi, 2020).

Specifically, in the service sector, different countermeasures have been addressed to preserve employees' health without damaging the business. For instance, most organizations required their employees to perform their work from home as much as feasible, especially those conducting asynchronous work (Graves and Karabayeva, 2020). Whenever working from home was not an option, organizations changed their policies to mitigate social exposure and risk of contagion in the work environment by performing re-distribution of work shifts and redesign of workstations (Qiu et al., 2020; Béland et al., 2020). Since no vaccine or cure are already available, these countermeasures are generally focused on diminishing the opportunities for human contact or providing proper personal protection in the work environment. Regardless, most organizations were forced to quickly re-structure their processes and services to cope with the pandemic effects (Ivanov and Das, 2020).

At the same time, some of these service organizations have been implementing lean over the past years. The first reports on lean implementation in service organizations (also denoted as Lean Service) date back from the late 1990s and early 2000s (e.g. Bowen and Youngdahl, 1998; Allway and Corbett, 2002; Ahlstrom, 2004). Analogously to the original concept of Lean Manufacturing, Lean service seeks to systematically reduce waste and improve quality throughout the whole value stream of service organizations (Suarez-Barraza et al., 2012; Hadid and Mansouri, 2014). Evidence of lean implementation in services is prolific, with organizational contexts that vary from restaurants (Keyser et al., 2017; Alles et al., 2018) and educational institutions (Balzer et al., 2015; Allaoui and Benmoussa, 2020) to hospitals (Waring and Bishop, 2010; Borges et al., 2020) and banks (Oppenheim and Felbur, 2014; Bakri, 2019). In general, those authors conclude that lean

services implementation positively impacts organizations' performance, enabling more flexible and effective operations oriented to customers' needs.

However, the COVID-19 outbreak poses a whole new scenario with unprecedented challenges to those service organizations. Additionally, the organizational changes and their consequences to businesses are not fully known (Zhang et al., 2020), which raises doubt on how lean implementation in services can cope with the pandemic effects. Thus, based on these arguments, the following research question arises:

RQ. *What is the impact that the COVID-19 pandemic and its work-related implications have on the relationship between lean implementation and services performance?*

To answer this question, we surveyed 106 leaders from service organizations that maintained their activities remotely during the COVID-19 outbreak. These services organizations have been implementing lean for at least two years. Multivariate data analysis techniques were applied to examine the dataset. This study was drawn on socio-technical systems (STS) theory, which states that organizational development may be achieved through the proper interaction between social and technical aspects of an organization, leading to performance improvements (Cooper and Foster, 1971; Walker et al., 2008; Cecconi, 2016). STS has already been adopted to ground research on lean services (e.g. Hadid and Mansouri, 2014; Hadid et al., 2016), being useful to support a more holistic view of the problem. In this sense, our research sheds light on how the pandemic affects the impact of Lean Service implementation on performance, providing both theoretical and practical contributions to the field.

The rest of our article is structured as follows. Section 2 consolidates the literature allowing the development of the investigated hypothesis in our study. Section 3 describes the methodology adopted, whose results are presented and discussed in section 4. Finally, section 5 closes the paper

presenting implications of our findings to both theory and practice on the field, as well as limitations that can motivate future studies.

2. Background and hypothesis development

2.1. Lean Service

The lean paradigm was initially acknowledged within the manufacturing context, more specifically referring to practices and principles applied in the automotive industry that could lead to superior performance results (Krafcik, 1988; Womack et al., 1990). Later, the concept of lean systems was expanded to other organizational contexts, such as services. However, some authors (e.g. Bowen and Youngdahl, 1998; Ahlstrom, 2004) claimed that the implementation of those lean principles and practices in service organizations required some adaptation, resulting in the term 'Lean Services'. Such adaptation may also occur according to the type of service organization undergoing the lean implementation (Suarez-Barraza et al., 2012; Alsmadi et al., 2012).

Due to the increasing social and economic relevance of services in most countries, management approaches that favor the continuous improvement of those organizations, such as Lean Service, have gained more attention from researchers. In this sense, literature has not only encompassed the underlying principles and practices of Lean Service (e.g. Bicheno, 2008; Leite and Vieira, 2015; Zirar et al., 2020), but also proposed assessment methodologies that allow verifying the readiness level of service organizations (e.g. Malmbrandt and Åhlström, 2013; Gupta and Sharma, 2018). Complementarily, other studies have focused on supporting aspects necessary for a successful lean implementation in service organizations. For instance, Tortorella et al. (2019) examined the leadership behaviors associated with a well-succeeded lean implementation in

hospitals. Burch and Smith (2019) investigated the use of simulation to teach Lean Service for millennials. Cudney and Elrod (2011) expanded the scope of Lean Service implementation from the organization to the supply chain, comparing their findings between service and manufacturing contexts.

Overall, studies on Lean Service have reported similar benefits from its implementation, such as improvements on quality and delivery (Hadid and Mansouri, 2014), cost reduction (Piercy and Rich, 2009), more innovative services (Ojasalo and Ojasalo, 2018), shorter lead times (Cavdur et al., 2019), higher employee satisfaction (Laureani and Antony, 2010), increased efficiency through standardization of processes (Carlborg et al. (2013), among others.

Thus, the expectation of obtaining these benefits together with the need for more competitive businesses have motivated service organizations worldwide to adopt Lean Services extensively.

2.2. COVID-19 work implications

The COVID-19 pandemic has caused significant changes in the way organizations, communities and people interact. Although those changes are fundamentally aimed at mitigating the pandemic effects on human health, they also entail other unintended negative consequences to society (Zhang et al., 2020). From an economic standpoint, the pandemic has negatively affected growth, since most countries redirected their capital expenditures to equip their healthcare systems better, reducing investments in other sectors (Béland et al., 2020). Further, governments have restricted the export of several items so that they could be reserved for internal consumption (Guerrieri et al., 2020). This has generated a cascade effect on the global economy, reducing market demand for non-essential goods and services, and increasing unemployment rates. From a social

perspective, the establishment of lockdown policies as a countermeasure to decelerate the contamination rate of the COVID-19 has caused physical and physiological damages to people, entailing an increase in domestic violence (Bradbury-Jones and Isham, 2020), depression (Berg-Weger and Morley, 2020) and alcohol consumption (Rehm et al., 2020), for instance.

These socio-economic changes have also impacted organizations' routines. To maintain their business active and cope with the guidelines indicated by most of the health and government authorities, organizations were pushed to revise their work policies (Nicola et al., 2020; Qiu et al., 2020). These changes in work policies aimed at ensuring the health and safety of employees during the COVID-19 outbreak. Organizations have re-structured their processes so that employees could either work remotely or with a reasonable distance and personal protection to avoid contamination (Bartik et al., 2020). Thus, employees were encouraged to distance themselves, performing their activities from home or with a minimum level of physical interaction. This new work scenario has been supported by extensive utilization of information and communication technologies (Elavarasan and Pugazhendhi, 2020; Ågerfalk et al., 2020). Table 1 summarizes some of the most frequent work implications of COVID-19 outbreak. However, the intensity of such work implications may vary according to the industry sector.

Table 1 – Work implications of COVID-19 outbreak

2.3. COVID-19 work implications, Lean Service and STS theory

Services account for more than 70% of GDP in high-income, and more than 55% in low- and middle-income countries (World Bank, 2017). Such economic representativeness aggravates the

need for both governments and organizations to find ways to sustain business even during an extremely critical period, such as this pandemic. In fact, the "new normal" implied by the pandemic has led service organizations to reinvent themselves, so that they could keep providing value to their customers (Gössling et al., 2020; Kabadayi et al., 2020). Additionally, services are also essential to (and constitute a large share of) many firms in the manufacturing sector (Rabetino et al., 2017). In other words, the increasing servitization of manufacturing may lead imply to those companies similar effects as pure service organizations. In this sense, organizations that can adapt more rapidly to this scenario might benefit, obtaining competitive advantages (Rapaccini et al., 2020).

As organizations implement Lean Service, a continuous improvement *momentum* is installed based on a problem-solving and customer-oriented culture (Radnor and Osborne, 2013; Hong et al., 2014; Ojasalo and Ojasalo, 2018). Paradoxically, the high level of process standardization implied by a lean implementation favors a more flexible organization (Spear and Bowen, 1999; Spear, 2008), corroborating with sudden process redesign needs, such as the ones entailed by the pandemic. However, as emphasized by previous studies (e.g. Dabhilkar and Åhlström, 2013; Hadid and Mansouri, 2014; Hadid et al., 2016; Tortorella et al., 2017a), successful lean implementation depends on addressing both social and technical aspects, which is aligned with STS theory's assumptions.

STS theory states that organizations are comprised of two components: technical and social. While the former includes equipment, tools, techniques and processes, the latter encompasses people and relationships among them (Cooper and Foster, 1971; Trist, 1981). Although these are separate components, achieving superior performance requires that they improve interdependently. This means that the exclusive emphasis on one component will not lead to the optimal performance of

the system (Fox, 1995; Walker et al., 2008). The need for joint efforts on social and technical components might become an issue in the current COVID-19 outbreak.

As aforementioned, one of the main countermeasures addressed by governments and organizations is to foster social distancing as a means to reduce the odds of contagion. Although information and communication technologies can mitigate most of the issues, inevitably, the interaction among employees will be impaired to some extent. This "new normal" can also jeopardize the level of information sharing and employees' engagement, which are essential for a successful Lean Service implementation (Rüttimann et al., 2014; Sum et al., 2019). Thus, following STS theoretical assumptions, we claim that the work implications of COVID-19 outbreak undermine the social aspects that complement the technical side of a Lean Service implementation. To investigate this, we formulate the following hypotheses:

H1: *The COVID-19 outbreak and its work-related implications negatively mediate the relationship between lean implementation and service organizations' quality performance.*

H2: *The COVID-19 outbreak and its work-related implications negatively mediate the relationship between lean implementation and service organizations' delivery performance.*

3. Method

This research aims at investigating the pandemic's effect and its work-related implications on the relationship between lean implementation and performance in service organizations. Since it is an exploratory research, the methodological procedure followed an empirical approach. Empirical studies are an adequate manner of gaining knowledge through direct or indirect observation or experience (Goodwin, 2005). The quantification of empirical evidence gathered from non-random

respondents that meet certain criteria is a common approach in similar studies (e.g. Tortorella et al., 2015a; 2015b; 2017b). The survey method is often used because of its high level of representativeness, low cost, good statistical significance and a standardized stimulus to all respondents (Montgomery, 2013). Thus, the selected research design encompassed a survey-based study with leaders from service organizations comprised of four main steps: (*i*) questionnaire development, (*ii*) sample selection and data collection, (*iii*) validity and reliability of constructs, and (*iv*) data analysis.

3.1. Questionnaire development

Before items were displayed, the questionnaire explicitly stated the anonymity and confidentiality nature of the study, and that there was no right or wrong answer. Subsequently, four parts composed the applied instrument (see Appendix A). The first part asked information about respondents and their organizations. This part also asked the respondent whether he/she was working remotely during COVID-19 outbreak, in order to identify those who met this criterion. In the second part, we assessed the implementation level of lean services practices in each organization. For that, we adopted the instrument proposed by Malmbrandt and Åhlström (2013), adapting seventeen items related to lean practices in service organizations. Those items were evaluated based on a 6-point ordinal scale, varying from 1 (not implemented) to 6 (fully implemented). The third part verified the work implications of COVID-19 outbreak. Ten work implications retrieved from Table 1 were stated. Those ten work implications were assessed through an ordinal scale that ranged from 1 (fully disagree) to 6 (fully agree). Finally, in the last part, the improvement level of the organizational performance during the past two months was asked. Following Domberger and Fernandez (1999), Hadid and Mansouri (2014) and Hussain et

al. (2019), two organizational performance indicators were used: quality and delivery. These measures were assessed based on a scale where 1 denoted a 'significantly worsened' performance, and 6 referred to a 'significantly improved' performance.

As recommended by Podsakoff and Organ (1986) and Podsakoff et al. (2003), we located the independent (lean services practices) and mediating (COVID-19's work implications) variables far from dependent ones (performance improvement) in order to avoid common method bias. The questionnaire was pre-tested by two academicians to check for content and face validity. Their inputs allowed the revision of some terms and statements so that misinterpretations and erroneous responses were mitigated.

3.2. Sample selection and data collection

Three criteria were initially defined to select respondents. The first one required that respondents should belong to service organizations that have been implementing lean for a minimum of two years. Second, all respondents should be working remotely during COVID-19 pandemic, so that the aimed working context was ensured. Third, respondents must play a leadership position in their organizations, such as coordinator, supervisor, manager or director. This criterion would help legitimize respondents' perceptions concerning the whole organization, avoiding a myopic view of the current state. The non-random choice of organizations for survey-based research is a commonly used strategy in other studies on lean given the establishment of specific selection criteria (Shah and Ward 2007; Boyle et al., 2011; Tortorella et al., 2017c).

Questionnaires were sent through emails in April 2020 to respondents from service organizations located in India, which was the fourth country most affected by the COVID-19 in terms of infected

cases according to The Times of India (2020). At the time of our data collection, India was on a 21-day lockdown with all domestic and international flights suspended. Further, India took bold decisions to fight the pandemic, such as screening people at ports of entries, tracing contacts, training health workers, scaling up testing capacities, preparing health facilities and engaging with communities (DW, 2020). With regards to businesses and organizations, only critical services and companies (e.g. healthcare, food retailers, etc.) remained with the doors open. However, the Indian government announced some economic schemes to provide credit and reduce taxes, so that most businesses could keep functioning even with lower demand rates (Mondaq, 2020).

558 potential respondents that met the selection criteria were identified. Those were already part of network of some of the authors due to previous consultancy, research and collaboration activities. In May 2020, a follow-up message was sent re-invite those who have not responded to the survey yet. The final sample consisted of 106 responses, entailing a 19.0% response rate. We checked the dataset for non-response bias between respondents who answered in April (early respondents; $n_1 = 49$) and the ones who answered in May (late respondents; $n_2 = 57$). For that, we used Levene's test for equality of variances and a t-test for equality of means (Armstrong and Overton, 1977). Results did not show significant differences in means and variances between groups. Harman's single-factor test with an exploratory factor analysis was also utilized to test common method bias (Malhotra et al., 2006). The test encompassing all independent, mediating and dependent variables resulted in a first factor that accounted for 21.62% of the total variance. Since there was no single factor explaining most of the variance, we did not consider common method bias issues.

In terms of respondents' characteristics, 67.9% were either supervisors or coordinators, and 59.4% had less than 5 years of experience. 57.5% of the service organizations were transnational (located

in multiple countries); 86.8% were private; 61.3% had less than 5,000 employees; and 35.8% were from the infrastructure sector (e.g. communications, transportation, utilities, banking). Regarding the degree of interaction and customization, 85.8% of respondents claimed that their service organizations presented a high level, and 71.7% informed their organizations had a high degree of labor intensity (see Appendix B). In general, service organizations that present both high labor intensity and interaction/customization are denoted as 'professional services', since they tend to have highly trained specialists providing individual attention to customers (Fitzsimmons et al., 2008).

3.3. Validity and reliability of constructs

Two Exploratory Factor Analysis (EFA) using Principal Component (PC) extraction were carried out to identify and validate constructs based on the collected data. EFA is mainly utilized when a scale needs to be developed, identifying the latent constructs of variables (Fabrigar et al., 1999). Further, EFA is recommended when hypotheses or patterns of measured variables are not known upfront (Finch and West, 1997).

The first EFA was conducted with lean services practices (see Table 2). All seventeen practices resulted in high loadings (> 0.45) in the first PC (Hair et al., 2014), with an eigenvalue of 11.55 and accounting for 67.94% of the total variance in responses. Construct reliability was tested through the Cronbach's alpha, whose result ($\alpha = 0.803$) surpassed the 0.6 threshold indicated by Meyers et al. (2006). This construct was denoted as [LEAN_SERV], and represented the independent variable in our study. The utilization of a single dimension to refer to lean implementation is quite common in previous studies with similar objectives (e.g. Gupta and Sharma, 2018; Tortorella and Fettermann, 2018; Zirar et al., 2020).

Table 2 - EFA to validate lean services construct [LEAN_SERV] (adapted from Malmbrandt and Åhlström, 2013)

The second EFA used responses on the agreement level of work-related implications of COVID-19 outbreak to correctly identify constructs. Using varimax rotation, we retained two components with eigenvalues of 3.796 and 2.235, respectively, and representing 60.31% of the total variance. These components were named based on the respective variables that loaded in each one of them. In this sense, constructs of COVID-19's work implications were identified and labelled according to their predominant characteristics. We replicated results using an oblique rotation as a check for orthogonality and the extracted components were similar. Unidimensionality of each component was tested and confirmed through principal component analysis at a component level. Reliability was verified based on Cronbach's alpha. As shown in Table 3, Cronbach's alpha values indicated high reliability (> 0.6).

The first bundle consisted of work implications related to home office environment. A critical impact of the COVID-19 pandemic was that employees were encouraged to work remotely from home [HOME]. Such work-related implication requires a more extensive utilization of remote communication technologies (e.g. online platforms and email). Additionally, to maintain their efficiency levels, employees needed to adapt their homes so that the environment could properly support their daily work activities. The variables that loaded in this component were grouped and, hence, represented the pandemic's effects related to the home office environment. The second construct involved measures associated with the social distancing [SOCIAL] implied by the pandemic. Due to the absence of any vaccine or cure, the primary countermeasure against the COVID-19 has been so far to reduce people's contact (Lewnard and Lo, 2020). Thus, those

variables were grouped and indicated the work implication inherent to the social distancing derived from the COVID-19 outbreak.

Table 4 shows pairwise correlations and composite reliability (CR) for all variables and constructs. All significant correlation coefficients (p-value < 0.05) were positive, representing the nature of variables' interaction. Furthermore, all CR values were larger than 0.7, confirming the convergent validity of constructs (Hair et al., 2014). Hence, values for each validated construct were calculated based on their corresponding factor loadings and given on a continuous scale.

Table 3 – EFA to validate bundles of COVID-19 work implications (rotated component matrix)

Table 4 – Correlation coefficients and composite reliability of all constructs

3.4. Data analysis

The data analysis encompassed a set of Ordinary Least Square (OLS) hierarchical linear regression models so that our hypotheses could be tested. Four models were verified. The first two models regressed [HOME] and [SOCIAL] (mediating variables) on the control (degree of interaction and customization, and degree of labor intensity) and [LEAN_SERV]. Both models were also tested with organization sectors as dummy variables, since process and service considerations inferred by the sector could impact on the work implications of COVID-19 outbreak. The five sector-type dummies were not significant, and results remained the same as when these variables were excluded from the regression models. We also pre-tested the effects of the remaining control variables related to respondents (role, gender and experience) and organizations (size, type and

ownership). None of those variables presented significant effects on the dependent variable of interest. Therefore, organization sector, type, ownership and size, and respondent's role, gender and experience were disregarded in the regression models to increase the degrees of freedom and significance of our tests. Models 3 and 4 regressed quality and delivery improvement on the control, independent and mediating variables, respectively.

Assumptions of normality, linearity, and homoscedasticity between independent, mediating and dependent variables were verified following Hair et al. 's (2014) recommendations. We examined residuals to confirm the normality of the error term distribution. Concerning linearity, we checked it by plotting partial regression for each model, which indicated that none of the models rejected the hypothesis of adherence to the normal distribution of residuals. Finally, homoscedasticity was visually analyzed by plotting standardized residuals against predicted value. All checks supported the assumptions for an OLS regression analysis.

4. Results

Table 5 presents the standardized $\hat{\beta}$ coefficients for the OLS regression analyses. Variance inflation factors (VIFs) in the regression models were all lower than 3.0, suggesting that multicollinearity was not a concern (Hair et al., 2014). Models 1 and 2 examined the effect of [LEAN_SERV] on [HOME] and [SOCIAL] constructs, respectively, which were hypothesized as the mediating variables. In both models, [LEAN_SERV] appears to be positively associated with the COVID-19's work implications ($\hat{\beta} = 0.727$; p-value < 0.01; and $\hat{\beta} = 0.437$; p-value < 0.01, respectively).

In the third model, we regressed quality improvement of service organizations on the control (Model 3A), independent (Model 3B) and mediating variables (Model 3C). All three analyses led to significant models (*p*-value < 0.10). Nevertheless, Model 3C showed the highest predicting capacity of quality improvement with an adjusted R^2 of 0.469, significantly enhancing the prediction of Model 3B. In Model 3C, both [LEAN_SERV] and [HOME] were positively associated with this dependent variable ($\hat{\beta}$ = 0.299; *p*-value < 0.01; and $\hat{\beta}$ = 0.448; *p*-value < 0.01, respectively), while no significant effect was found for [SOCIAL].

When considering delivery as the performance metric of services, the analyses performed in the fourth model indicated that Model 4C was the one with a superior capacity of prediction (adjusted R^2 = 0.421; *F*-value = 16.297; *p*-value < 0.01). In other words, this result suggests that when the mediating variables are inserted, the improvement level related to delivery performance is better explained by this model. This is particularly true for [HOME], whose coefficient ($\hat{\beta}$ = 0.324) had a *p*-value lower than 0.01. Analogously to Model 3C, Model 4C also indicated that [LEAN_SERV] is directly and positively related to delivery improvement ($\hat{\beta}$ = 0.413; *p*-value < 0.01), and no significant result was found for [SOCIAL].

Table 5 – Standardized $\hat{\beta}$ coefficients of the hierarchical regression models

These findings partially support our hypotheses, although the mediation orientation found (positive mediation) was contrary to the hypothesized one (negative mediation). Service organizations are mainly composed by office areas (either front-office or back-office) that manage and operate diversified flows of information, processes, equipment, people and, sometimes, materials

(Nankervis et al., 2005). An effective lean implementation may change not only the practices and techniques used in the organization, but also install new work habits that impact on people's behavior (Chiarini, 2012; Rüttimann et al., 2014). Further, previous studies (e.g. Di Pietro et al., 2013; Hadid and Mansouri, 2014; Li et al., 2017) have already evidenced the benefits of lean implementation on services performance. With the advent of the COVID-19 outbreak, service organizations had to re-structure themselves to manage the pandemic effects, reinforcing the home office environment as a way to keep employees safe and healthy, and businesses active. Because the surveyed leaders were actively engaged in the lean implementation in their organizations, they are prone to replicate their work habits and behaviors in their home office environment, which would lead to similar benefits as the ones observed within the organization. The positive mediation performed by *home office environment* on the relationship between *lean services* implementation and services' performance (delivery and quality improvement) might be explained by the replication of individuals' work habits and behaviors at home. This positive mediating effect is illustrated in Figure 1. Thus, our findings indicate that service organizations that have been implementing lean services more extensively are also more likely to benefit from the COVID-19's work implications, especially by home office environment. Additionally, it is important to notice that, despite the level of the COVID-19's work implications, Figure 1 indicates that the impact of lean adoption overrides the mediating effect of home office. In other words, although a positive mediation of home office was identified, organizations that extensively adopt lean are likely to perceive significant improvements on both quality and delivery during the pandemic, as expected.

Figure 1 – Mediation of home office environment on the relationship between lean services adoption and services quality and delivery improvement

On the other hand, results did not support the mediating role of social distancing on the relationship between lean services implementation and organizational performance. This lack of mediation was somewhat surprising, as we hypothesized a negative mediation for this work implication. Following STS theory, organizations need to address both technical and social aspects to successfully implement changes (Long, 2018). According to Saurin et al. (2013), Tortorella et al. (2017a) and Soliman et al. (2018), the implementation of lean systems features within STS concepts, as lean practices may represent the technical aspects while organizational culture might be used as a proxy for the social ones. Complementarily, Freitas et al. (2018) have emphasized that lean implementation impacts the behaviors, attitudes and skills of individuals through the establishment of a learning environment. When social distancing occurs, organizations need to foster such learning environment in different manners (Echeverri and Åkesson, 2018), so that employees keep sharing knowledge and demonstrating the desired behaviors for a successful lean implementation. If organizations fail to do so or take too much time to readapt their processes and work routine in the face of the pandemic, the social attributes required for a successful lean implementation might fall short, undermining their performance. Although the absence of a significant mediation played by social distancing did not support this rationale, it may also suggest that service organizations are still struggling with this specific work implication of the COVID-19. In other words, our results indicate that the implementation of Lean Service has a positive association with social distancing, mitigating its effects since the statements in the questionnaire were written in a favorable way (see Table 3). Nevertheless, social distancing does not appear to mediate the effects of lean services on both quality and delivery performances, which is somewhat aligned with findings from Jung and Yoon (2019).

5. Conclusions

This study aimed at investigating the impact of the COVID-19 pandemic and its work-related implications on the relationship between lean implementation and services performance. Two constructs of work implications were empirically verified: (*i*) home office environment and (*ii*) social distancing. We found a positive mediating effect of home office environment, and no significant mediation for social distancing. Our findings have contributions to both practice and theory, deserving further discussion in the subsequent sections.

5.1. Theoretical contributions

From a theoretical perspective, our study evidenced that service organizations that have been implementing lean over the past few years are more prompt to face extreme disruption events, such as the one caused by the COVID-19 pandemic. In general, lean implementation seeks to reduce *muda*, *mura* and *muri* (i.e. waste, variability and overburden, respectively) (Womack and Jones, 1997). As organizations improve their processes and services, they tend to become more flexible to adapt to external demands and changes from customers, suppliers or competitors. In this study, these changes were particularly implied by the COVID-19 outbreak (home office environment and social distancing), affecting the whole society and supply chains similarly. Nevertheless, service organizations that extensively implement lean practices are more likely to benefit from those work implications of the pandemic, achieving enhanced performance results for both quality and delivery. This is a unique contribution to the body of knowledge on lean.

Another relevant finding is that social distancing does not seem to undermine the relationship between lean services implementation and organizations performance. The absence of a significant mediating effect suggests that these organizations are not aware of how concurrently balancing the implementation of practices (technical aspects) and the social aspects related to lean implementation affected by the social distancing. Moreover, because the effect of lean services implementation on performance improvement seems to override the positive mediation of home office, one may assume that as organizations more extensively adopt lean, both social and technical aspects are concurrently addressed. This might establish transparent, standardized and robust processes in which employees can effectively perform their tasks, regardless of the work environment. In other words, as lean adoption increases, both social and technical aspects become more mature, favoring the establishment of efficient work environments even when employees are working physically apart from each other. To undoubtedly state this, further empirical evidence would be necessary. However, our research raises the attention of academicians to this issue, indicating that the effects of certain work implications of COVID-19 outbreak may not have clear outcomes on the management practices (e.g. lean) within service organizations.

5.2. Implications to practice

The COVID-19 pandemic is a phenomenon that has disrupted organizations and supply chains of the entire world, motivating the establishment of alternative work structures and routines. Services industry represent a significant part of the economy and, due to its diversity, has found its own solutions to curb and mitigate the pandemic's impact. However, if not properly managed, such countermeasures can jeopardize businesses, leading to diminished performances. Our study has provided managers evidence that organizations that present a more extensive adoption of lean

practices may not have their performance negatively affected by the 'new normal' implied by the pandemic.

A successful lean implementation entails a profound change in work habits and employees' behaviors, such as discipline, respect, collaboration, systemic view, and appreciation for standards. Such behavioral shift might be extended to other environments besides the organizational context. Our findings suggest that employees may replicate the behaviors they demonstrate in the organization at their homes. Such fact helps to overcome potential barriers implied by this 'new normal' way of working, corroborating to the continuous development of the organization. This outcome can spark permanent changes in the way service organizations are structured, with unique implications for the post-pandemic period.

5.3. Limitations and research opportunities

Although several countermeasures have been addressed, this study presents some limitations that need to be discussed. The first one refers to the sample size utilized in our research. Even though our dataset allowed the performance of the multivariate data analysis techniques, larger samples could provide a more diversified sample and the utilization of other sophisticated data analysis techniques, such as structural equations modelling. Thus, we encourage future studies to increase the sample size and diversify the respondents in terms of services sectors, leading to novel and complementary insights. A second limitation is related to the work implications encompassed in our study. Because the COVID-19 outbreak is a recent phenomenon, the observation of longer-term work implications becomes very subtle. For instance, one of the main effects of the pandemic has been a quick change on services demand, either reducing or increasing it significantly. Particularly for service organizations that have faced a sudden drop in demand, the consequent

organizational slack could potentially impact the organization capacity to deliver the service on time, influencing our results. Therefore, there may be other relevant implications that were not considered here and deserve to be examined, as well. Finally, we investigated the mediation of the COVID-19's work implications on lean implementation effects. For that, our data analysis indicated the existence of one single construct to represent lean services adoption. Although it was statistically robust, future studies could discriminate lean services implementation in different constructs and include them in similar analyses. This would potentially lead to other insights that could complement our findings. Additionally, there are service organizations that might have decided to adopt other continuous improvement approaches, such as six sigma or digitization. In this sense, further research involving other management approaches would enlighten how the 'new normal' implied by pandemic may contribute or conflict with them.

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Services Quality Improvement

Services Delivery Improvement

Lean Services Adoption

Lean Services Adoption

● Low HOME □ High HOME —— Linear (Low HOME) – – Linear (High HOME)

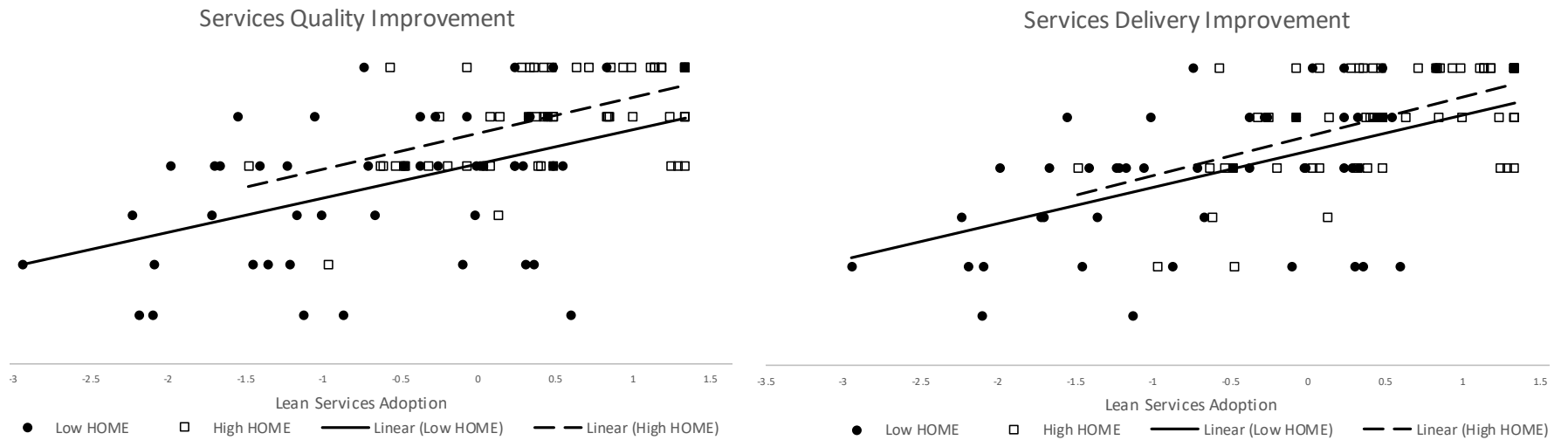● Low HOME □ High HOME —— Linear (Low HOME) – – Linear (High HOME)

Figure 1 – Mediation of home office environment on the relationship between lean services adoption and services quality and delivery improvement

Table 1 – Work implications of COVID-19 outbreak

COVID-19's work implications	Qiu et al. (2020)	Nicola et al. (2020)	Lewnard and Lo (2020)	Zhang et al. (2020)	Béland et al. (2020)
I have more frequently used email to communicate with my suppliers, customers and/or team members	√	√	√	√	
I have more frequently used online platforms to communicate with my suppliers, customers and/or team members	√	√	√	√	
I have more frequently used the telephone to communicate with my suppliers, customers and/or team members		√	√		
I have more frequently used websites to communicate with my suppliers, customers and/or team members	√	√	√		√
My work environment is neat and organized			√	√	√
My work environment presents the necessary infrastructure to support my activities		√		√	√
My work environment allows me to properly concentrate and focus on my daily duties	√			√	√
My work environment allows me to have a flexible routine (i.e. flexible hours)	√			√	√
I significantly do not miss the physical interaction with my colleagues	√	√	√		√
I do not face difficulty in approaching my coworkers	√	√	√	√	

Table 2 - EFA to validate lean services construct [LEAN_SERV] (adapted from Malmbrandt and Åhlström, 2013)

Variables	Mean	Std. Dev.	Communalities	Lean services [LEAN_SERV]
Identification of customer value	4.801	1.463	0.688	**0.829**
Customer involvement and feedback	4.745	1.359	0.696	**0.834**
Value stream mapping	4.358	1.422	0.641	**0.801**
Workplace design for smooth process flow	4.471	1.281	0.716	**0.846**
Connecting the process cross-functionally	4.509	1.388	0.758	**0.871**
Standardized tasks in all areas	4.481	1.455	0.671	**0.819**
Proactive planning to reduce process variability	4.405	1.364	0.723	**0.850**
Built-in quality	4.311	1.430	0.688	**0.830**
Pull systems to avoid wastes not demanded by the customer	4.198	1.564	0.743	**0.862**
Visual signals in all processes	4.009	1.539	0.610	**0.781**
Visualization of general information	4.330	1.465	0.654	**0.809**
Visualization of improvements	4.301	1.500	0.597	**0.773**
Multifunctional teams spanning functional boundaries	4.603	1.418	0.673	**0.820**
Participation in improvement work in teams	4.566	1.280	0.744	**0.863**
Continuously improving the entire flow	4.481	1.353	0.764	**0.874**
Problems are never solved in "firefighting" manner	4.160	1.480	0.446	**0.668**
Improvements are sustained involving both employees and managers	4.528	1.318	0.740	**0.860**
Eigenvalues extraction sums of squared loadings				11.55
% of variance				67.94
Cronbach's alpha				0.803
KMO measure of sampling adequacy				0.935
Bartlett's test of sphericity (χ^2 / df)				1,888.43 / 136[**]

Notes: Extraction method: Principal Component Analysis; [**] p-value < 0.01.

Table 3 – EFA to validate bundles of COVID-19 work implications (rotated component matrix)

Variables	Mean	Std. Dev.	Communalities	1	2	Denomination
I have more frequently used email to communicate with my suppliers, customers and/or team members	5.084	1.317	0.629	**0.725**		
I have more frequently used online platforms to communicate with my suppliers, customers and/or team members	5.103	1.393	0.547	**0.650**		Home office environment [HOME]
My work environment is neat and organized	4.886	1.229	0.701	**0.834**		
My work environment presents the necessary infrastructure to support my activities	4.811	1.295	0.675	**0.819**		
My work environment allows me to properly concentrate and focus on my daily duties	4.745	1.227	0.772	**0.877**		
My work environment allows me to have a flexible routine (i.e. flexible hours)	4.811	1.380	0.420	**0.647**		
I have more frequently used the telephone to communicate with my suppliers, customers and/or team members	4.849	1.602	0.561		**0.654**	Social distancing [SOCIAL]
I have more frequently used websites to communicate with my suppliers, customers and/or team members	3.962	1.886	0.448		**0.555**	
I significantly do not miss the physical interaction with my colleagues	4.292	1.626	0.629		**0.791**	
I do not face difficulty in approaching my coworkers	3.217	1.701	0.649		**0.795**	
Extraction sums of squared loadings				4.314	1.717	
% of variance				43.14	17.17	
Rotation sums of squared loadings				3.796	2.235	
% of variance				37.96	22.35	
Cronbach's alpha				0.809	0.831	
KMO measure of sampling adequacy				0.782		
Bartlett's test of sphericity (χ^2 / df)				495.35 / 45[*]		

Notes: Extraction method: Principal Component Analysis; Rotation Method: Varimax with Kaiser normalization; [*] p-value < 0.01.

Table 4 – Correlation coefficients and composite reliability of all constructs

Variables	1	2	3	4	5	6	7	CR
1-Degree of interaction and customization	-	0.406[**]	0.233[**]	0.191[*]	0.120	0.088	0.111	-
2-Degree of labor intensity		-	0.246[*]	0.147	-0.003	0.211[*]	0.219[*]	-
3-LEAN_SERV			-	0.725[**]	0.420[**]	0.623[**]	0.624[**]	0.789
4-HOME				-	0.364[**]	0.658[**]	0.597[**]	0.800
5-SOCIAL					-	0.269[**]	0.210[*]	0.807
6-Quality Improvement						-	0.890[**]	-
7-Delivery Improvement							-	-

Notes: [*] Correlation is significant at 0.05 level (2-tailed); [**] Correlation is significant at 0.01 level (2-tailed).

Table 5 – Standardized $\hat{\beta}$ coefficients of the hierarchical regression models

Variables	HOME	SOCIAL	Quality Improvement			Delivery Improvement		
	Model 1	Model 2	Model 3A	Model 3B	Model 3C	Model 4A	Model 4B	Model 4C
Degree of interaction and customization	0.042	0.075	0.003	-0.097	-0.115	0.027	-0.072	-0.080
Degree of labor intensity	-0.049	-0.141	0.210**	0.097	0.118	0.208*	0.096	0.102
LEAN_SERV	0.727***	0.437***		0.622***	0.299***		0.617***	0.413***
HOME					0.448***			0.324***
SOCIAL					-0.005			-0.071
F-value	38.074***	8.133***	2.389*	22.638***	19.523***	2.621*	22.470***	16.297***
R^2	0.528	0.193	0.044	0.400	0.494	0.048	0.398	0.449
Adjusted R^2	0.514	0.169	0.026	0.382	0.469	0.030	0.380	0.421
Change in R^2				0.355***	0.094***		0.349***	0.051**

Notes: * p-value < 0.10; ** p-value < 0.05; *** p-value < 0.01.