Front- and Back-end Employee Satisfaction During Service Transition

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FRONT- AND BACK-END EMPLOYEE SATISFACTION DURING SERVICE TRANSITION

Abstract

Purpose – Scholars studying servitization argue that manufacturers moving into services need to develop new job roles or modify existing ones, which must be enacted by employees with the right mentality, skill sets, attitudes, and capabilities. However, there is a paucity of empirical research on how such changes affect employee-level outcomes.

Design/methodology/approach – We theorize that job enrichment and role stress act as countervailing forces during the manufacturer's service transition, with implications for employee satisfaction. We test our hypotheses using a sample of 21,869 employees from 201 American manufacturers that declared revenues from services over a 10-year period.

Results – We find an inverted U-shaped relationship between the firm's level of service infusion and individual employee satisfaction which is flatter for front-end staff. This relationship differs in shape and/or magnitude between firms, highlighting the role of unobserved firm-level idiosyncratic factors.

Practical implications – Servitized manufacturers, especially those in the later stage of their transition (i.e., when services start to account for more than 50% of annual revenues), should try to ameliorate their employees' role-induced stress to counter a drop in satisfaction.

Originality/value – This is one of the first studies to examine systematically the relationship between servitization and individual employee satisfaction. It shows that back-end employees in manufacturing firms are considerably affected by an increasing emphasis on services, while past literature has almost exclusively been concerned with front-end staff.

Keywords Service infusion, Servitization, Job enrichment, Role theory, Employee satisfaction

1. INTRODUCTION

To compete effectively in the marketplace, manufacturers tend to "infuse" their product business with services (e.g., Benedettini *et al*., 2015; Gomes *et al*., 2021; Kowalkowski *et al*., 2012) varying from ad hoc maintenance to sophisticated performance-based contracts (e.g., Baines *et al*., 2014). Developing and adopting service-based business models is often referred to as "servitization" of manufacturing (Baines *et al*., 2009; Visnjic and Van Looy, 2013) and constitutes a strategic priority for service research (Ostrom *et al*., 2015). The transformation process from a goods-based manufacturing organization to a successful service-oriented business, i.e., the "service transition," has attracted considerable academic interest (Baines *et al*., 2020; Fang *et al*., 2008; Huikkola *et al.,* 2020; Kowalkowski *et al*., 2015; Rabetino *et al*., 2018). Yet, the literature has largely neglected this transition's implications for employees and the resultant tensions that they may experience in their job roles and responsibilities. Without studying and addressing individual-level concerns, such as the need for fulfilling jobs and the stress induced by role changes, academic understanding of servitization will remain only partial.

Successful transformation requires manufacturers to align various organizational aspects to the novel service-based business models, by adapting their human resources, measurement and reward systems, processes, and structures (Gebauer *et al*., 2010; Neu and Brown, 2005). That challenging endeavor entails product and service business units competing for limited resources (e.g., capital and management attention) to be divided between existing product activities (e.g., R&D and manufacturing process improvements) and developing capabilities (e.g., relationship and contract management), processes (e.g., service design), and culture (e.g., people and customer orientation) necessary for effective service provision (Gebauer *et al*., 2010). Attempts to integrate product-centered and service-centered customer orientations can compromise sales targets and service objectives, resulting in internal tension,

confusion, and even leading to organizational conflict (Gabler *et al*., 2017; Kohtamäki *et al*., 2020). This makes it necessary for organizations to learn to reconcile and cope with the paradoxical tensions they encounter (Chaudhary *et al.,* 2022; Kohtamäki *et al*., 2020; Visnjic *et al.,* 2022).

Thus, servitization constitutes a major organizational redirection in terms of both strategy and structure. Hence, the roles, routines, and tasks of individual employees must be modified (or fundamentally redesigned) to establish the "right" employee attitudes and culture (e.g., Kreye, 2016; Oliva and Kallenberg, 2003; Mathieu, 2001). However, despite extensive research on service transition at the *organization level*, targeted, empirical work on its implications for individual employees is missing, beyond a few in-depth case studies (Johnstone *et al*., 2014; Kreye, 2016). Those focus almost exclusively on salesforces and report strong resistance to change (e.g., Lenka *et al*., 2018; Ulaga and Reinartz, 2011). Salespeople need extensive training to develop the right knowledge, skills, and attitudes to fulfill their new roles, but evidence suggests that they might do so involuntarily or perceive it as irrelevant (Karatzas *et al*., 2020; Ulaga and Loveland, 2014). No work has systematically studied changes in *individual-level* behaviors and job outcomes at manufacturers transitioning into services. To our knowledge, no research has been conducted on the service transition effect on employee satisfaction, which is a strong predictor of employee performance (see Judge *et al*., 2001) and turnover (Rubenstein *et al*., 2018), as well as organizational performance (e.g., Symitsi *et al*., 2018). This study then aims to uncover the relationship between service transition and employee satisfaction to shed light on an unexamined conceptual issue of servitization, whilst also providing managers with valuable insights into human resource practices and policies that will not compromise employee well-being. Addressing this gap requires rigorous and relevant research to advance servitization theory and practice (Rabetino *et al*., 2021).

This study is aimed at addressing the following research question:

RQ: How does the manufacturer's service transition influence the employees' subjective job satisfaction?

We address this question by drawing on two distinct literature domains—the job characteristics model (JCM) of Hackman and Oldham (1976) and role theory (Biddle, 1979; Katz and Kahn, 1978)—to argue that *job enrichment* and *role stress* are the latent mechanisms at play during service transition, linking the level of service infusion and employee satisfaction in a nonlinear manner. From our theorization on the evolution of the two countervailing forces, we postulate an inverted U-shaped relationship between the level of service infusion and employee satisfaction. We also hypothesize that the relationship is flatter for front-end employees.

We test our hypotheses in a repeated cross-sectional sample of 201 US-based manufacturers (21,869 individual employees) after combining employee satisfaction ratings ('overall', as well as satisfaction with four distinct aspects) from the job seeking website Glassdoor, with COMPUSTAT firm financial data. The latter is also used to construct each firm's "service ratio," i.e., the proportion of its revenues derived from service activities (see Fang *et al*., 2008), which is our service infusion proxy. We find that as manufacturers move toward higher levels of service infusion, individual employee satisfaction increases at a diminishing rate until services account for approximately 55% of total revenues, then gradually decreases. That baseline effect varies significantly (in shape and/or magnitude) among manufacturers. The findings suggest that servitizing firms should provide employees with fulfilling jobs and support them to reduce their levels of role stress.

The paper is structured as follows. We first theorize on job enrichment and role stress in the context of service transition then develop our hypotheses. Details of the data collection and analysis procedures follow, then the results. The theoretical and managerial implications conclude this work.

2. THEORETICAL BACKGROUND

To theorize on the effects of service transition—or, equivalently, of the increase in *service infusion* (e.g., Kowalkowski *et al*., 2013; Ostrom *et al*., 2010)—on employee satisfaction, we draw from two distinct theories: the job enrichment research tradition and the strand of role theory concerned with behaviors within organizations. We argue that job enrichment and increased role-induced stress act as countervailing forces during a manufacturer's service transition. Which force prevails depends on the service infusion level. In this section we discuss research on the effects of job enrichment and role stress on employee-level outcomes, before examining the implied form of the relationship between those latent mechanisms and the level of service infusion. We also highlight arguments, abundant in the servitization literature, regarding the implications of reorganizing front- and back-end employees and how their roles change during service transition, leading to conflicting demands and tensions that need to be managed.

2.1 The JCM and job enrichment during service transition

Hackman and Oldham's (1975) seminal study defines five core job characteristics which trigger positive psychological states to improve job outcomes. *Skill variety* (i.e., the various skills and activities required to perform a job), *task significance* (i.e., the outcome's importance to the lives and work of others), and *task identity* (i.e., the extent to which the job hinges on the completion of "whole" and identifiable tasks) increase an employee's experienced meaningfulness of work. *Job autonomy* (i.e., how free an individual is to design and schedule their work) prompts perceived responsibility and accountability through an employee's significant control over their job. Received *feedback* (i.e., the level of direct and

clear information about employee's performance) improves an employee's knowledge of their contribution to organizational outcomes.

The basic JCM premise is that "enriching" job roles with these characteristics will ultimately lead to improvements in both positive employee-level outcomes (e.g., productivity and satisfaction) and negative ones (e.g., absenteeism and turnover) (Allan *et al*., 2019; Humphrey *et al*., 2007). Research has revealed strong associations between the five job characteristics and work satisfaction (e.g., Fried and Ferris, 1987; Loher *et al*., 1985). Later meta-analyses (Humphrey *et al*., 2007; Allan *et al*., 2019) reinforce those findings. For example, Humphrey *et al*. (2007) show that job characteristics explain 34% and 24% of the variance in job satisfaction and organizational commitment, respectively.

The literature is replete with conceptual arguments and empirical evidence suggesting that individual employee roles become richer during the service transition process. The macroeconomic shift from manufacturing to services and the accompanying technological advancements have been proposed as drivers of increased *task identity* (National Academy of Sciences, 1999). In servitization, as a manufacturer's service business develops, more employee tasks require interpersonal interactions and collaboration with coworkers, suppliers, customers, and clients (Burton *et al*., 2017; Neu and Brown, 2005). As the manufacturer's employees become immersed in providing tailored, customer-specific "solutions" (Tuli *et al*., 2007), their perception of task identity is expected to increase (Wegman *et al*., 2018). They are also likely to experience their work's immediate impact on others, thereby enhancing their sense of *task significance*. With financial incentives and rewards increasingly linked to appropriate service-related behaviors and tasks (e.g., bonuses for selling more services, see Burton *et al*., 2016; Kohtamäki *et al*., 2020; Storbacka, 2011), employees must feel that their tasks are increasingly important, leading to improved motivation and enthusiasm (e.g., Homburg *et al*., 2003; Kreye, 2016).

Increased interpersonal interactions and service encounters suggest that employees must rely on cognitive and interpersonal skills (Neu and Brown, 2005) frequently. That might strengthen their *skill variety* perception. Training and personal development opportunities (Antioco *et al*., 2008; Kreye, 2016), for example, will enable employees to use the new technologies in which servitizing firms invest (e.g., Coryenen et al., 2017; Vendrell-Herrero, Bustinza and Opazo-Basaez., 2021), and should also enhance skill variety and address individuals' needs for growth and self-actualization, while sustaining high levels of motivation and job security (Kreye, 2016).

Furthermore, the increased customer orientation necessary for providing services (Kothamäki *et al.,* 2020) fuels decision-making authority decentralization to lower-level managers, and organizational teams (Eggert *et al*., 2014; Gebauer *et al*., 2010; Vendrell-Herrero, Bustinza, and Opazo-Basaez., 2021), whose sense of *autonomy* and responsibility should increase (Kohtamäki *et al*., 2020; Neu and Brown, 2005). Finally, the improved information-sharing routines that follow servitization (e.g., through the intensified use of IT systems and frequent face-to-face meetings) better inform employee decisions by breaking down communication barriers and expediting information exchange, ultimately allowing timely *feedback* (Coreynen et al., 2017; Kohtamäki *et al*., 2020).

In summary, from a JCM standpoint, these changes in job characteristics should positively impact employee-level outcomes. However, the servitization literature has not examined how these positive changes co-evolve with the competing demands of product and service orientations. Nor has it considered the cognitive and emotional stress that such changes to employee roles may exert (cf. Dmitrijeva *et al.,* 2022), leading to the experience of paradoxical tensions, that is, "contradictory yet interrelated elements that exist simultaneously and persist over time" (Smith and Lewis, 2011, p. 382). Role theory might provide the lens to shed light on this issue.

2.2 Organizational role theory and role stress during service transition

Role theory is a vast research domain. Its main presumption is that people hold social positions and maintain expectations for their own and others' behaviors (Biddle, 1985). In professional life, this involves acting in accordance with organizational role expectations (Katz and Kahn, 1978). Such roles are learned and validated through interactions with colleagues, superiors, and customers (Solomon *et al*., 1985). During their professional "enactments," employees often face situations with no clearly articulated and/or conflicted roles (Van Sell *et al*., 1981). Role stressors can thus be found embedded in the nature of professional roles.

Role stress affects how well employees perform job tasks and can instigate processes that result in anxiety, burnout, and exhaustion (LePine *et al*., 2005). In the academic literature, the concept of role stress encapsulates *role ambiguity*, *role conflict*, and *role overload*. Role conflict refers to an incongruence between role expectations and demands (Bettencourt and Brown, 2003), while role ambiguity captures the vagueness (and an individual's lack of understanding) of role requirements, responsibilities, behaviors, or tasks (Gilboa *et al*., 2008). Role overload refers to situations with too many demands under time or other constraints (Bolino and Turnley, 2005). Unsurprisingly, ample evidence exists of the three stressors' deleterious effects on individual employee attitudes, performance, and satisfaction (Bedeian and Armenakis, 1981; Singh, 1998; Tubre and Collins, 2000), either directly or indirectly, through constructs such as "burnout" (Ambrose *et al*., 2014), which eventually damage commitment to the organization and core firm-level outcomes (e.g., Arnold *et al*., 2009).

We contend that the required redesign of individual job roles will lead to job-related stress. Role theory emphasizes that whenever roles change, as during the organizational restructuring required for servitization, expectation inconsistencies and lack of information regarding effective behaviors will emerge (Biddle, 1979; Tubre and Collins, 2000). Indeed,

Sjödin *et al*. (2016) specifically studied role ambiguities and conflicts (e.g., vague expectations, unclear role descriptions, and uncertain role scripts) inherent in the provider–customer relationship during the service transition process. These ambiguities stem from several issues echoed in the servitization literature: insufficient communication and coordination of activities, unspecified operative requirements, increasingly complex contracting, unclear views on how to address unanticipated demands, and the risk of service failures (Benedettini *et al*., 2017; Finne *et al*., 2013). Similarly, Parida and Jovanovic (2022) argue that role ambiguities can detrimentally affect employee perceptions of how they conduct themselves within the organization and toward its customers. These might lead employees to experience a tension of belonging (Smith and Lewis, 2011), that is, a tension between one's own identity and that of the wider group (Dmitrijeva *et al.,* 2022; Raja *et al.,* 2022). This manifests itself as conflicting demands placed upon employees for their loyalties to the product or service parts of the business (Visnjic *et al.,* 2022).

From a more general standpoint, Lenka et al. (2018) argue that due to the co-existence of a product orientation centered around efficiency and standardization, and a service orientation that hinges on heterogeneity and flexibility, employees will experience ambivalence, i.e., a pull towards desirable but contradictory alternatives. The (emergent) contradictory goals, incompatible behavioral expectations, and cultural and political tensions (Finne *et al*., 2013; Neu and Brown, 2005; Oliva and Kallenberg, 2003), coupled with pressures to learn new skills, will exacerbate role *ambiguity*, *conflict*, and *overload* (Gabler *et al*., 2017; Lenka *et al*., 2018). As a result, individual employees and coalitions thereof (e.g., operations, R&D, and sales) may feel that their established expertise, power, and competences are under threat (Josephson *et al*., 2016) and become reluctant to leave their comfort zones, accept process changes, engage in service activities, and learn new skills (e.g., Burton *et al*., 2016).

These employees need to learn to navigate and cope with the paradoxical tensions experienced in their roles during service transition (Kohtamäki *et al*., 2020; Chaudhary *et al.,* 2022).

2.3 The case of front-end employees

The service transition literature discusses reconfiguring activities into front-end and back-end units (e.g., Davies *et al.,* 2006; Oliva and Kallenberg, 2003; Raja *et al*., 2018; Sawhney, 2006). Customer-facing front-end units are advocated for developing and delivering services while managing customer contact (Chase, 1981), whereas back-end units support the front-end by developing products for service (Sawhney, 2006). Interaction between the front- and back-end employees is considered important for efficiency in processes and capability development during the service transition (Jovanovic *et al.,* 2019).

Front-end employees (e.g., salespeople, online customer support, and field service personnel) are the company's face, with notable importance for effective and efficient product-service provision (Storbacka, 2011; Tuli *et al*., 2007; Ulaga and Reinartz, 2011). Their boundary-spanning position enables them to access knowledge possessed by dispersed customers (e.g., Rothaermel and Hess, 2007), which can be translated into new or improved product-service offerings (Neu and Brown, 2005). Customer satisfaction and loyalty largely depend on the values, attitudes, and behaviors exhibited by front-end staff (e.g., Prior, 2013), leading to a reevaluation of their organizational identity (Huikkola *et al.,* 2020).

Business models like servitization that change the "traditional" service encounter, have transformed the roles of customer-facing employees (Larivière *et al*., 2017), who are expected to be ambidextrous (Gabler *et al.,* 2017) and do more than before (Prior, 2013). For example, product salespeople are assigned new responsibilities such as selling services (Gebauer and Friedli, 2005), liaising with external partners (Sawhney, 2006), and aligning the organization's corporate strategy with that of key customers (Neu and Brown, 2005). They need to interact,

frequently and for longer periods, with multiple internal and external stakeholders, not just the narrowly defined set (e.g., buyers and machine operators) as is the case in pure product selling (Ulaga and Loveland, 2014). They have to upskill to become customer "advisers" or "consultants" (Chakkol *et al*., 2018) managing expectations and anticipating risks in a flexible manner (Prior, 2013). Similarly, service people need to check in regularly with customers and follow up on service encounters (Brady and Cronin, 2001) while also stimulating product and service demand (Gabler *et al*., 2017).

In addition, the proliferation of digital technologies, such as Internet of Things (IoT), digital twins, machine learning and augmented reality, to name a few, have also led to the production of large amounts of data that require employees to possess the requisite analytical skills (Tronvoll *et al.,* 2020). In many instances, such technologies enable the automation of work tasks, whereas in others automation and augmentation cannot be easily separated from one another (Raisch & Krakowski, 2021). Front-end employees performing service work may find that such technologies augment their routines and decision-making, which in turn may reduce their autonomy and increase work pressure.

This will require a new professional profile, "T-shaped" people, who possess deep problem-solving skills in one area and a broad range of transferable skills (Spohrer and Maglio, 2010; Storbacka, 2011). Such demands leave little doubt that front-end staff role stress will increase; the question is how the rate of increase compares to that for back-end employees. We examine this issue in the next section and formulate a separate hypothesis for the effect of service infusion on front-end staff satisfaction.

3. HYPOTHESES DEVELOPMENT

3.1 The effect of service infusion on employee job satisfaction

During the earlier stages of service transition, the redesigned tasks and roles make the day-to-day employee experience with their work more meaningful, thus generating a higher sense of achievement (Hackman and Oldham, 1980; Kreye, 2016). However, we posit that the (earlier) radical transformation of job roles should logically give way to (subsequent) minor adjustments in tasks and responsibilities, especially as more sophisticated practices and routines with a dual product-service orientation are adopted (Visnjic *et al.,* 2022). It is therefore unlikely that the relationship between service infusion and job enrichment would be linear. Instead, the crystallization of roles at higher levels of service infusion will lead to a leveling off (i.e., further service infusion at later stages of the service transition will be associated with comparatively smaller increases in job enrichment). We thus assert that the overall relationship between the level of service infusion and job enrichment will be concave.

We also suggest that the sources of *individual-level* role stress (e.g., ambivalence, incompatibility of expectations, complex contracting, and cultural tensions) will be even more consequential once manufacturer has moved to higher levels of service infusion. As individuals are drawn further away from their original expertise, with established product-oriented behaviors and norms being replaced, role-induced stress might increase at an increasing rate. Even at a new "equilibrium," where organization-level routines and processes are set, with the strategic mix of products and services firmly decided as being primarily driven by services, individual employees will be "performing" roles that are relatively more loaded, ambiguous, and conflicting. As such, they will need to accept the higher levels of stress or, as the literature suggests, be replaced by individuals with the "right" mentality and attitudes (e.g., Reinartz and Ulaga, 2008) who are more capable of coping with those stressors. We thus assert that the relationship between service infusion and role stress will be convex; on average, as the

importance of the service business for the company increases, individual employee role stress will increase at an increasing rate.

This increase in role stress might also be exacerbated by the recent move toward digital servitization (Kohtamäki *et al.,* 2019, 2022; Sklyar *et al.,* 2019), which places additional requirements on employees to be knowledgeable about advanced digital technologies (Tronvoll *et al.,* 2020). This might be especially hard for older employees, who might be pressed to acquire knowledge, skills, and abilities without which the will not be able to fulfil their 'newer,' enriched roles. For some employees, such a change might be perceived as a threat and cause tension (Tronvoll *et al.,* 2020), especially in situations where paradoxical goals of achieving operational efficiency and customization are being pursued (Kohtamäki *et al.,* 2020). Firms pursuing digital servitization are then likely to need to recruit employees with a "compatible" mindset to work with large amounts of data and advanced digital technologies (Tronvoll *et al.,* 2020). Increasing demands upon workers will then lead to the stretching of their roles.

From the above, we posit that two latent processes will be at play as the manufacturer's level of service infusion increases: a) roles and tasks will become richer and more meaningful but at a decreasing rate (i.e., concave); and b) role stress will increase at an increasing rate (i.e., convex). As job enrichment efforts affect employee satisfaction positively (e.g., Humphrey *et al*., 2007), and role stress affects it negatively (e.g., Bedeian and Armenakis, 1981), the additive effect of the two latent mechanisms on employee satisfaction will be curvilinear (Haans *et al*., 2016) (i.e., their countervailing influence will manifest as an inverted U-shaped relationship between service infusion and employee satisfaction).

Hypothesis 1: There will be an inverted U-shaped relationship between the firm's level of service infusion and individual employee satisfaction; as the importance of services for a firm increases, employee satisfaction will increase up to a point before decreasing.

3.2 Service infusion and satisfaction for front-end employees

It has long been argued that multiple and sometimes conflicting organization, customer, and supervisor demands (e.g., Cordes and Dougherty, 1993) make front-end employees, on average, more susceptible to role stress and subsequent burnout (Singh *et al*., 1994). Indeed, studies of front-end employees show strong associations between role ambiguity, conflict, and overload, on the one hand, and depersonalization and emotional exhaustion on the other (e.g., Ambrose *et al*., 2014; Cordes and Dougherty, 1993).

It is reasonable to argue then, that front-end employees begin with naturally higher levels of role stress when their employer starts transitioning into services. This might make them increasingly unwilling to accept the additional stress associated with redesigned tasks, added obligations, fuzzy customer expectations, and unique product-service offerings.

The accumulated qualitative evidence suggesting strong resistance to change by such employees might be a testament to this. Indeed, Reinartz and Ulaga (2008) found that even after extensive training, dissatisfaction was common among salespeople and led to staff turnover (Ulaga and Reinartz, 2011). In some cases, up to 80% of the salesforce needed to be replaced due to the considerable gap between the demands placed on individuals and their capability and willingness to sell hybrid offerings (Ulaga and Loveland, 2014). The contradictory incentives, and the need to move away from a mindset of convincing the customer to buy a piece of equipment to collaborating in designing the best possible "solution" to fuzzy customer specifications, are not something that everyone can cope with (Reinartz and Ulaga, 2008; Ulaga and Loveland, 2014). Hence, it is possible that in the early stages of service transition, role stress for front-end employees will rise at a relatively faster rate with changes in roles and responsibilities.

However, and given how critical these employees are for effective provision of *advanced* service offerings and solutions (e.g., Tuli *et al*., 2007), the targeted training, ensuing attrition, and "fire and hire" organization-level HR tactics for front-end staff (Reinartz and Ulaga, 2008) will gradually result in sales and service functions consisting of individuals with more suitable culture, attitudes, and behaviors. As such, the rate of increase in role-induced stress of an 'average' customer-facing employee will be lower for higher levels of service infusion (when compared to back-end employees). This dynamic suggests a faster early increase in role stress with service infusion, with a subsequent attenuation of the relationship for higher service infusion levels (although it remains convex). As demonstrated mathematically in the Online Supplement (following Haans *et al*., 2016), this suggests a flatter inverted U-shaped relationship between service infusion and front-end employee satisfaction (see Haans *et al*., 2016).

Hypothesis 2: The inverted U-shaped relationship between the firm's level of service infusion and individual employee satisfaction will be relatively flatter for front-end employees.

Figure 1 illustrates the theorized latent mechanisms for both employee types (giving rise to differential relationships between service infusion and employee satisfaction). The two hypotheses are illustrated pictorially in Figure 2.

[Insert Figure 1 here]

[Insert Figure 2 here]

4. METHODOLOGY

We test the hypotheses in a sample of manufacturers from four industries that are considered in the literature as the epicenters of servitization: industrial machinery (NAICS 333), computer and electronic products (NAICS 334), electrical equipment and appliances (NAICS 335), and transportation equipment (NAICS 336). The focus on firms whose offerings traditionally comprise relatively complex and long-life products excludes manufacturing industries in which the concepts of "service" and "product-service offering" might mean something completely different (e.g., paper product manufacturers and oil producers). As such, we used COMPUSTAT to identify all firms with *primary* NAICS 333-336. As detailed in what follows, we then matched this sample of firms with a dataset supplied by Glassdoor, a job search engine and employee review website. Data from this source is increasingly utilized in business and management research, including fields like finance (Dube & Zhu, 2021), management science (Campbell & Shang, 2021), information systems (Hu et al., 2019) and operations management (Gupta et al., 2022).

4.1 Measures and data collection

Service infusion. As the level of service infusion is interlinked with a manufacturer's service orientation, it is often assumed to be reflected in: (1) the number of services offered, (2) the number of customers offered the service, and/or (3) the company's emphasis on the service business (Antioco *et al*., 2008; Homburg *et al*., 2003; Raddats *et al*., 2019). However, despite the multifaceted nature of service infusion, researchers have increasingly employed a simple measure derived from secondary data as its proxy (e.g., Fang *et al*., 2008; Josephson *et al*., 2016; Patel *et al*., 2019; Suarez *et al*., 2013). This is the firm's "service ratio," i.e., the proportion of its total revenues that come from service activities. Following this growing research tradition, we calculate the service ratio of every manufacturer from the selected

industries using data from COMPUSTAT Business Segments. The latter provides firm revenues for different business operating segments, as defined by the firm's management. From the segment descriptions and their respective NAICS/SIC codes, we categorize them into service and nonservice, following the process laid out in Visnjic et al. (2019). For each firm-year, we calculate the service ratio by dividing the sales revenues from all service business segments by the firm's total annual revenue. As disclosing revenues *by segment* is a voluntary managerial practice, selection bias is possible. This is because some firms choose to break down their annual revenues into their sources (segments), while others 'lump' them together into their primary industrial classification (which, by definition, is their product business). As such, following past literature (e.g., Fang *et al.,* 2008; Visnjic *et al.,* 2019), we consider only firms reporting revenues from a service segment at least once in our time frame. That leaves us with 201 companies.

Employee satisfaction. This refers to all characteristics of the job itself and the work environment that employees find satisfying or unsatisfying (Churchill *et al*., 1974). Our satisfaction measure comes from Glassdoor. Our main interest lies in Glassdoor's "overall satisfaction" rating. However, in the Online Supplement, we also analyze four separate dimensions of satisfaction. Specifically, satisfaction with: a) compensation and benefits, b) senior leadership, c) career opportunities, and d) work–life balance. All measures range from 1 to 5, hence they are ordinal by design. As detailed in section 4.3, we apply appropriate econometric modelling techniques to account for this. As Glassdoor employee reviews begin in 2008, that is the start of our time frame, which ends in 2017. To avoid retrospective information (Green *et al*., 2019), we drop all reviews by self-declared former employees. As we cannot trace when they left, it is impossible to tell which year their reported satisfaction refers to, thus introducing an intractable bias. We are left with 21,869 reviews from current employees of the 201 manufacturers over a 10-year period. Overall, our dataset can be

described as a repeated cross-section, since we have different cross-sections of employees every year reviewing their employer. Glassdoor does not identify individual employees, so it is impossible to account in our modeling for multiple reviews by the same person. Nevertheless, it is unlikely that the proportion of repeat reviewers is substantial or that it would have any noticeable influence on the results.

Employee role. To separate front-end from back-end employees, we classify Glassdoor's aggregate role categories. For example, reviews by employees categorized as "customer service," "sales representative," or "product support" are coded as front-end in our data set. We operationalize employee role with a dummy variable taking the value of 1 for a front-end employee's review.

Control variables. In our models we include four key firm-level covariates, data for which comes from COMPUSTAT. A growing research tradition has established an association between the level of a firm's service infusion (the explanatory variable of interest) and its financial performance (e.g., Fang *et al*., 2008; Visnjic and Van Looy, 2013). The relationship between employee satisfaction (the dependent variable) and organization-level performance outcomes has also been widely studied across various disciplines (see Harter *et al*., 2002; Symitsi *et al*., 2018). We control for this possible confounding by including in the models the firm's *net profit margin* and *return on assets*. To account for the possibility that employee satisfaction and proxies of financial performance are jointly determined in period *t*, we use the lagged values of the two covariates (i.e., in year *t -1*). As the squared term of return on assets considerably increases model fit, it is also inserted in all models.

R&D intensity captures the extent of a firm's commitment to continual innovation of its offering (Gebauer *et al*., 2011) and determines the success of new product development efforts (Raassens *et al*., 2012). Strong product innovation might attenuate product-oriented employees' concerns that the firm is losing its strategic focus and technology-based identity. It

might also lead to improvements of the products to which services are tied, thus fostering the development of integrated "solutions" that more effectively address customer needs (Josephson *et al.,* 2016; Neu and Brown, 2005), allowing the firm to move to higher levels of service infusion. We measure R&D intensity through the firm's (lagged value of) annual R&D expenditure.

Larger firms might find it relatively harder to reorient their strategy and culture during service transition (Neely, 2008) and move to higher levels of service infusion (Fang *et al.,* 2008). Additionally, *firm size* might be correlated with individual employee satisfaction. More importantly, larger firms are expected to be overrepresented in our employee reviews sample. Since the estimates will be dominated by such overrepresented firms, if they happen to be more (/less) servitized on average and their employees systematically more (/less) satisfied, the derived relationship between service infusion and employee satisfaction will be biased. To account for any confounding effect of size, we use the natural logarithmic transformation of the number of employees in year *t*.

We further utilize Glassdoor's aggregate role categories to classify employees into "job zones" based on their levels of education, experience, and training necessary to perform their work.[1] The constructed five-level categorical variable (operationalized as a set of four dummy variables) is the only other employee-level characteristic, since we were unable to source consistent information for sex, age, or educational attainment. Unsurprisingly, 86% of the reviews in our sample come from managerial-level employees. Although it is not of direct interest, we include *job zone* in all models.

Finally, to account for time-invariant industry-level characteristics, such as technological intensity and product lifespan (Vendrell-Herrero, Vaillant, Bustinza and Lafuente, 2021), all models include a dummy variable for each primary NAICS code (with 333 acting as the base level).

4.2 Descriptive statistics

Sample summary statistics can be found in Table 1. Table 2 presents the distribution of overall satisfaction rating by the top, medium, and bottom quintiles of the service ratio for both front-end and back-end employees. It suggests that both groups are highly satisfied in firms with very high or very low levels of service infusion. The bulk of the satisfaction distribution for both groups is at ratings 3 and 4, but front-end employees submit relatively more extreme ratings (1 and 5).

[Insert Table 1 here]

[Insert Table 2 here]

Figure 2 illustrates how service ratio and employee satisfaction have evolved over time across the entire sample. Over 2008–2017, the mean fraction of firm revenues from services approximately doubled from about 20% to 40%. Average employee satisfaction dipped slightly after the financial crisis before hovering at around 3.4 (out of 5) from 2012. Front-end staff are generally slightly less satisfied with their job (on average), possibly due to the relatively more stressful nature of their role.

[Insert Figure 3 here]

4.3 Estimation framework

Our dataset is a repeated cross-section of employees reviewing their employers in different years. It has a hierarchical structure: employees "nested" within years, "nested" within firms. Given this feature of the dataset, and to account for the ordinal nature of the dependent variables, we use a multilevel (random-effects) ordered probit framework (detailed later). Multilevel (hierarchical) models do not treat clustering within firms as a nuisance but as something of substantive interest. As such, one can investigate the between-firm variability in

employee-level outcomes (e.g., individual satisfaction), as well as the effects of higher-level, time-varying firm characteristics (e.g., level of service infusion). In addition, one can disentangle the *within* from the *between* or *contextual* effect with appropriate model transformations (see Antonakis *et al.,* 2021; Bell and Jones, 2015). Our interest is in the former, namely, how individual employee satisfaction within a firm, changes as the firm moves to higher levels of service infusion.

The multilevel framework also allows for the coefficients of service infusion to vary by firm (due to unobserved firm-level variables)—commonly referred to as a "random coefficient model" (e.g., Bell and Jones, 2015). This is a desirable and relevant property given the context, for the following reason. The servitization literature provides ample evidence of diverse challenges faced by manufacturers shifting toward services, and a differential effectiveness in tackling them. This effectiveness depends on various (relatively) fixed firm-level characteristics and capabilities that differ between companies and ultimately determine servitization success. For example, one such high-level characteristic is the firm's service climate (Antioco *et al*., 2008; Lytle *et al*., 1998), which encompasses factors such as service orientation (of the organizational structure and corporate culture), top management commitment, learning opportunities, measurement and financial rewards, networking capabilities, and cross-functional communication (e.g., Baines *et al*., 2020; Gebauer *et al*., 2010; Yan *et al*., 2020). These might also play a role in how employees respond to the firm's ongoing strategic redirection. Accordingly, top management enabling active participation, autonomy, and quality feedback will better motivate individuals (Gebauer *et al*., 2010) and help them to cope with role stress (e.g., Singh, 1998). Overall, employees finding themselves in firm contexts more (/less) conducive to servitization will feel relatively more (/less) satisfied with the firm's move toward higher levels of service infusion. In other words, although we have hypothesized an inverted U-shaped relationship between the level of service infusion and

individual employee satisfaction in the "average" firm, our random coefficient model allows us to test whether some firms deviate from this pattern.

For simplicity and given our study's short time frame, we use a set of dummy variables to account for the firm-year level, treating time as "fixed." This helps us to account for any year-specific influences on employee satisfaction or service infusion level and for any possible trends in the theoretically motivated but unobserved determinants of job satisfaction (e.g., task identity and significance, see Wegman *et al*., 2018). The firm-level means of all variables are also included in all models. Originating in Mundlak (1978), this approach accounts for firm-specific unobserved characteristics potentially affecting the level of service infusion and employee satisfaction, thus it addresses possible violations of the "random-effects assumption" (i.e., that the random effect is uncorrelated with the regressors. See Antonakis *et al*., 2021). The coefficients of the explanatory variables are therefore interpreted as the *within* effects, while the coefficients of the firm-level means are the *contextual* effects on the assumed *latent* satisfaction.

We specify a two-level hierarchical model, the most complex specification of which includes the interaction term of service infusion and employee role (testing Hypothesis 2), and treats the coefficients of the linear and quadratic terms of service infusion as random. The model can be represented mathematically as a linear latent response model where the employee-level *latent* job satisfaction (i.e., utility) U^*_{itj}, is linearly related to $\mathbf{S}_{tj}$, representing a (2×1) vector containing the service ratio variable and its squared term, F_{itj}, the front-end dummy variable, $\mathbf{X}$, a vector of the "control" variables, including all covariates discussed in the methodology section and all firm-level means, and D_t, the time dummy variables. That is:

$$U_{itj}^{*} = \beta_{0j} + \boldsymbol{\beta}_j' \mathbf{S}_{tj} + \beta_3 F_{itj} + \boldsymbol{\gamma}'(\mathbf{S}_{tj} \times CF_{itj}) + \boldsymbol{\delta}'\mathbf{X} + \Sigma_{t=2}^{11}\alpha_t D_t + \epsilon_{itj}, \qquad (1)$$

$$\beta_{0j} = \beta_0 + u_{0j},$$

$$\boldsymbol{\beta}_j' = [\beta_{1j} \quad \beta_{2j}],\ \beta_{1j} = \beta_1 + u_{1j},\ \beta_{2j} = \beta_2 + u_{2j},$$

where the u_{kj}, with $k = 0,1,2$, are the *random effects* and ϵ_{itj} are the *idiosyncratic errors*. Note that the u_{kj} are jointly normally distributed and assumed to be orthogonal to ϵ_{itj}.

Nevertheless, U_{itj}^{*} is unobserved. Instead, we observe each employee's Glassdoor rating, JS_{itj}, which takes a positive integer value from 1 to 5, denoting the satisfaction level, according to the following latent variable framework:

$$JS_{itj} = \begin{cases} 1 & if \quad U_{itj}^{*} < \kappa_1 \\ 2 & if \quad \kappa_1 < U_{itj}^{*} < \kappa_2 \\ \vdots & \vdots \quad\quad \vdots \\ 5 & if \quad U_{itj}^{*} > \kappa_5, \end{cases}$$

where $\boldsymbol{\kappa} = [\kappa_1, \kappa_2, ..., \kappa_5]$ are threshold estimable parameters. If we assume that the error terms ϵ_{itj} follow standard normal distributions, the above model can be represented by a multilevel ordered probit. All parameters of this model, β_0, β_1, β_2, $\boldsymbol{\gamma}$, $\boldsymbol{\delta}$, $\boldsymbol{\kappa}$, and the variances/covariances of u_{kj} are then estimated using Maximum Likelihood estimation, with a mean-variance adaptive Gauss-Hermite quadrature for integrating out the random effects (with seven integration points). We use the Stata 17 *meoprobit* routine to estimate all models.

It is important to note that this model's standard errors (SEs) need to be "clustered" at the firm-level because the error terms are expected to be correlated across employees of the same firms. If such clustering is not allowed, the resulting SEs will be downward biased, thus resulting in artificially inflated test statistics for the coefficients' statistical significance.

5. RESULTS

5.1 Overall employee satisfaction

Table 3 presents the results for overall employee satisfaction, which is the main outcome of interest. Model 1 only allows for a "random intercept" (i.e., no random slopes), and includes the service ratio and its squared term without any interaction terms with the front-end dummy. It provides overwhelming evidence that the satisfaction level differs between manufacturers, since the intercept variance estimate is almost six times its standard error. However, the coefficients of both terms of service ratio are statistically insignificant (despite having the hypothesized signs), which does not provide strong evidence that the within-firm effect of service infusion on employee satisfaction is, overall, of an inverted U-shape. However, when including the interaction terms between the service ratio variables and the front-end dummy (Model 2), thus allowing for the service infusion effect on satisfaction to differ between back-end and front-end employees, a clearer inverted U-shaped pattern emerges for the former. This is because of the positive and significant (at the 10% level) coefficient of the linear term of service ratio and the negative and significant coefficient of its quadratic term. Both interaction terms are statistically insignificant, which suggests that the service infusion effect for customer-facing employees is no different from that for back-end employees. However, their signs and magnitudes suggest a flatter inverted U-shaped relationship for the former, thus supporting Hypothesis 2.

Model 3 extends Model 1 by allowing for a random slope of service ratio leading to a large improvement in model fit (likelihood ratio test statistic of 98.12 versus Model 1; p-value < 0.01). The variances of the (random) coefficients of the linear and quadratic terms of service ratio are more than twice their SEs, suggesting that the service infusion effect varies across manufacturers. Model 4, our most advanced specification, extends Model 3 by including the interaction terms. This does not significantly improve model fit, but, as with Model 2, it

illustrates more clearly the within-firm effect of service infusion. Even after allowing for random coefficients, back-end employees experience an inverted U-shaped change in satisfaction as the level of service infusion increases (Wald test statistic of 4.89; p-value < 0.1), while the relationship is flatter for front-end employees but not statistically different (since the coefficients of both service infusion terms are statistically insignificant). Interestingly, a Wald test for the *total effect* of service infusion on front-end employee satisfaction suggests that the level of service infusion does *not* affect their satisfaction levels (Wald test statistic of 2.34; p-value = 0.31).

[Insert Table 3 here]

The within-firm effects for both employee groups can be illustrated graphically by plotting how the predicted probabilities of submitting an overall satisfaction rating of 5 change as the level of service infusion increases from 0 to 1 (Figure 4). As hypothesized, the relationship has an inverted U-shape for both groups, but it is flatter for customer-facing employees. For back-end employees, the probability of being highly satisfied increases from 0.2, when the service ratio is zero, to about 0.3 when the service ratio is about 55% (the turning point). A decrease to about 0.24 follows when the manufacturer transforms fully into a service provider. For front-end employees, the initial increase in the probability of being highly satisfied is smaller (from 0.2 to about 0.26). It then falls to 0.22 when the service ratio is 1.

[Insert Figure 4 here]

5.2 Satisfaction with other aspects of work

The analysis for the four specific work aspects can be found with a brief commentary in the Online Supplement. Overall, the results are in general agreement with the main analysis findings.

6. DISCUSSION AND CONCLUSION

This study constitutes one of the first systematic and quantitative attempts to investigate how service transition affects *employee-level* outcomes (Kowalkowski *et al*., 2012). With job enrichment and role stress proposed as the two relevant latent mechanisms, the results show that, as service infusion increases, employee satisfaction increases at a decreasing rate, up to a maximum point where service revenues contribute about 55% of the firm's total revenues. After that, the relationship becomes negative. This relationship is flatter, on average, for front-end staff but differs significantly across manufacturers. These findings have implications for both theory and practice that we detail below.

6.1 Theoretical contributions and implications

First, the inverted U shape within-firm effect suggests that employees become increasingly satisfied when their firm's service transition commences, until services account for about half of the firm's revenues. We have argued that this is because individual roles and tasks in that phase become enriched and considerably more meaningful (Gebauer and Friedli, 2005; Kreye, 2016), thus outweighing the negative influence of increasing role stress. This is encouraging evidence that manufacturers have managed to motivate individuals appropriately and create the right circumstances to negate the negative influence of role stress and its sources (e.g., complex contracts, contradictory incentives, and pressure to learn new skills. See Gabler *et al*., 2017; Lenka *et al*., 2018). In later phases, job enrichment's positive influence wanes as

stress becomes more influential, with reduced satisfaction as a result. The probability that a random employee is highly satisfied is at its lowest at the end of the firm's servitization journey, but that is still higher than it was before the service transition started (i.e., when the service ratio is zero). This suggests that the *net* effect of a manufacturer's transition into services on individual employee satisfaction is likely to be positive overall. These results provide important nuance to the research that has considered, however tangentially, human resource challenges during the service transition (e.g., Neu and Brown, 2005; Prior, 2013; Reinartz and Ulaga, 2008). They suggest that the situation for individual employees is less bleak than the literature suggests; individual-level satisfaction is likely to increase with service infusion.

Second, the flatter relationship for front-end employees suggests that, overall, their satisfaction is relatively less affected by the firm's service transition. This might seem counterintuitive given the emphasis placed by previous research on the challenges faced by transforming manufacturers with respect to customer-facing staff, especially salespeople (e.g., Ulaga and Loveland, 2014; Ulaga and Reinartz, 2011). While not denying the importance of the latter for successful servitization, our findings imply that servitization scholars might have overlooked the implications of service transition for back-end employee satisfaction and wellbeing. It is not just front-end roles that change dramatically with the manufacturer's transformation; most organizational routines, processes, and structures also change, not just those involving sales and service personnel. For example, operations and production employees need to enact an appropriate operations strategy (e.g., Baines *et al*., 2009), product engineers must design increasingly sophisticated products better integrated with service elements and addressing specific customer needs (e.g., Tuli *et al*., 2007), and human resource staff must assist the multifaceted transformation by designing appropriate incentives and appraisal procedures (e.g., Burton *et al*., 2016). We have provided evidence that such employees matter as much as salespeople and that servitization scholars should pay attention to them to better

understand their service transition experience. That said, the finding that front-end employees remain *less* likely to be satisfied with their work *throughout* the manufacturer's transition suggests that those individuals need to be managed very carefully.

Third, the results from the random coefficient models illustrate the idiosyncratic nature of the service transition journey. Despite the inverted U-shaped relationship between service infusion and individual employee satisfaction for the 'average' firm, the relationship differs significantly between manufacturers in terms of shape and/or magnitude. We alluded to a handful of unobserved firm-level factors responsible for this by drawing from case studies of manufacturers successfully and unsuccessfully adopting servitization (e.g., Baines *et al*., 2020; Burton *et al*., 2017; Forkmann *et al*., 2017). Despite this research strand's usefulness for uncovering enablers (e.g., service climate) and barriers (e.g., lack of management attention) to successful service transition, their potentially moderating role *specifically* for employee satisfaction should be examined systematically and complemented with quantitative studies.

Fourth, our findings need to be considered vis-à-vis the literature on servitization implications for firm performance, which is generally considered to be strongly associated with employee satisfaction. Research employing the Fang *et al*. (2008) service ratio as a measure of service infusion has generally produced nonlinear relationships between service-infusion and firm-performance measures, typically U-shaped (e.g., Fang *et al*., 2008; Suarez *et al*., 2013). Our findings suggest that, as services become increasingly important for firm revenues, *firm-level* performance and *employee-level* satisfaction might move in different directions. Manufacturers then face a conundrum: a stronger emphasis on services at already high levels of service infusion (i.e., service ratio around 55%) might increase profitability (according to past research findings) but, as this study suggests, at the expense of individual employee satisfaction. How can one reconcile these findings? First, one needs to appreciate the difference in levels (Klein *et al.,* 2013). Our study was conducted at the individual rather than the firm

level, so it is possible that theoretically correlated effects go in opposite directions depending on the level at which they are observed (Curran and Bauer, 2011). Moreover, neither this study nor past servitization research consider the temporal relationships among service infusion, employee satisfaction, and firm performance. It is conceivable that a manufacturer struggling with profit margins would move into services to recover its competitive advantage, but, while employees experience increasing satisfaction with their job roles, firm-level performance continues to drop before improving again (e.g., Fang *et al*., 2008). After a period at high levels of service infusion and improved performance, the negative influence of role stress kicks in and employee satisfaction starts to decrease. What happens next is an open question: there might be a drop in firm-level performance due to decreased employee satisfaction, or satisfaction and performance might stop being associated in manufacturers that are (close to being) *fully servitized.* Only a research framework that spans across levels and time, and considers employee-level satisfaction, firm-level service infusion, and performance simultaneously could shed light on this seeming paradox.

Finally, we should note that (following a plethora of academic studies) we have implicitly assumed that a manufacturer moves unidirectionally from selling standalone products to providing basic, then progressively more advanced, services. This assumption is being increasingly challenged from a theoretical as well as a practical standpoint (e.g., Kowalkowski *et al.,* 2015), and there are manufacturers that have strategically decided to reduce the number of services they offer, for example through divesting their service business. This trend is referred to as "service dilution" or "deservitization" (Finne *et al*., 2013; Kowalkowski *et al*., 2017). Indeed, the *service ratio* decreased in 44 of the 201 manufacturers in our sample during the study time frame. Assuming that decrease reflects a strategic decision to have a more optimal product-service mix, it might provide an additional explanation of the inverted U-shaped relationship. Those firms might have realized that they had moved too far

along the service continuum from their established firm- and employee-level competences and expertise. Reverting to a more balanced position might have improved employee satisfaction.

6.2 Implications for practitioners

Assuming that the posited latent mechanisms are indeed the drivers of the manifest relationship between service infusion and employee satisfaction, servitizing manufacturers should take action to increase the weight of job enrichment over role stress when transitioning into services. For example, they can try to nurture employee optimism, which has been found to reduce role conflict and ambiguity and their effect on satisfaction (Crosno *et al*., 2009). Customer orientation is another well-studied construct found to reduce role stress and improve job satisfaction. Although it is more likely a psychological state than a set of behaviors (see Zablah *et al*., 2012), socialization, training, and charismatic leadership can strengthen it. Developing employees' problem-solving skills can also make them more resourceful and thus better able to deal with role stress by viewing it as a problem to be solved. Line managers in servitized manufacturers might also want to identify those employees with naturally high levels of customer orientation and/or resourcefulness to work with to identify sources of role conflict and ambiguity, clarify roles and responsibilities, and agree performance measures.

Managers can also alter their recruitment and selection policies toward identifying individuals with ambidextrous orientations who can balance the (often) contradictory product and service business goals (Gabler *et al*., 2017; Lenka *et al*., 2018). This is especially relevant for front-end salespeople, who need to strike a balance between selling expensive equipment and long-term service packages to build customer-specific solutions generating the maximum customer value.

6.3 Limitations and future research

This work is not without its limitations. The Fang et al. (2008) service ratio deployed as a service infusion proxy here and in previous research reflects the relative importance of services, but it may have some drawbacks (Wang *et al*., 2018). First, many manufacturers may not distinguish between the revenues from their service and product business. Since the classification of revenues by segment is a managerial choice, and the firm's policy regarding such declaration, as well as the managers responsible for it, might have changed over time, the measure cannot be 100% accurate or consistent. Second, a high percentage of service revenues may not represent a high level of servitization. It might simply reflect low product sales due to an unsuccessful product business. Third, the measure is unable to capture fundamental changes in a manufacturer's business model (e.g., IBM's transformation from computer manufacturer to IT solutions provider). As it has been pointed out (e.g., Benedettini *et al.,* 2017), the service ratio might reflect neither the firm's *intent* to become servitized, nor its service orientation, but servitization *success*, i.e., an outcome of service transition. Fourth, the service ratio is agnostic when it comes to aspects such as whether the increase in service sales is entirely due to a large contract with a single customer, or of whether customer service provision is outsourced to a specialized partner, like a dealer or franchisee (e.g., Bustinza *et al.,* 2019). As such, the latent mechanisms of job enrichment and role stress might not be as applicable in every context where an increase in the service ratio is observed, challenging our theorization.

Nevertheless, despite all these drawbacks, it is the only known measure that allows a large-scale study like ours, so it has been extensively deployed in seminal studies (Josephson *et al*., 2016; Suarez *et al*., 2013). Developing more appropriate measures based on secondary data would be a promising research direction for servitization scholars. Moreover, the effect of service infusion on employee satisfaction can be examined after operationalizing service infusion in different ways (see Wang *et al*., 2018).

An additional limitation is that our sample is biased towards managerial-level employees (86%), with only 6% of reviews coming from lower-level employees such as customer service, laborers, and machine operators. As such, it is not representative of the population of employees of (servitizing) manufacturers. Arguably, this bias applies to most servitization research concerned with employee matters, but it makes it unclear whether our findings (and the theorized latent mechanisms) apply to all levels of the organization structure. Future servitization research should try to be more inclusive and understand how the service transition affects those individuals on the shopfloor.

Although we find that the effect of service infusion on some satisfaction measures differs between manufacturers, we do not measure any factor that could explain this variability. Future research could directly measure and incorporate moderators (at the individual and/or firm levels) to ground empirical explanations of our findings.

Moreover, although we theoretically explored the effects of stress on front-end and back-end workers when transitioning to services, there is scope for other researchers to build on this work by theoretically motivating and measuring the impact of different types of stress. For example, hyper-stress (e.g., when one is pushed beyond the limits of human adaptability), distress (e.g., the experience of frustration, sadness, and anxiety when goals are thwarted), emotional stress (e.g., the experience of exhaustion, burnout, fatigue, depression), techno-stress (e.g., the adverse effects of introducing and using new technologies), might be experienced at different degrees by front- and back-end employees, and affect satisfaction differently.

Finally, research will need to account for the recent trend toward digital servitization (see Kohtamäki *et al.,* 2019; Paschou *et al.,* 2020), which is now an integral part of the service transition discussion. Notably, the implications of advanced digital technologies on the roles and responsibilities of front- and back-end employees (and their satisfaction) require attention. Although the benefits of digital servitization for organizations, the environment and society

have been widely discussed (see Paschou *et al.,* 2020), the employee perspective needs to be accounted for more comprehensively.

[1] Based on the classification and terminology of O*net (see https://www.onetonline.org/find/zone?z=0&g=Go).

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ONLINE SUPPLEMENT

A. Mathematical representation of the asserted relationships between the main variables

Assuming that job enrichment (JE) increases with service ratio (S) at the same (decreasing) rate for *both* groups of employees, where the subscripts *b* and *f* denote back-end and front-end employees respectively, we have:

$$JE_b = JE_f = \alpha_0 + \alpha_1 S - \alpha_2 S^2 \qquad (1)$$

where $\alpha_0, \alpha_1, \alpha_2 > 0$

When it comes to role stress (RS) though, we have argued that front-end employees: a) start at a higher initial level of stress due to the nature of their work; b) experience a relatively sharper rise in stress during the early stages of the service transition; c) the effect will be attenuated at later stages. Mathematically then, role stress for the two groups during service transition can be represented as follows:

$$RS_b = \beta_0 + \beta_1 S + \beta_2 S^2 \qquad (2)$$

$$RS_f = (\beta_0 + \boldsymbol{\delta}) + (\beta_1 + \boldsymbol{\epsilon})S + (\beta_2 - \boldsymbol{\theta})S^2 \qquad (3)$$

where $\beta_0, \beta_1, \beta_2, \boldsymbol{\delta}, \beta_1 + \boldsymbol{\epsilon} > 0$ and $\boldsymbol{\theta} < \beta_2$

As argued in the paper, job enrichment and role stress are the two latent mechanisms at play, linking the level of service infusion with employee satisfaction (E). Their unobserved effect will be additive, hence, to derive the relationship between satisfaction and service ratio for the two groups of employees separately, we need to subtract the negative mechanism (role stress) from the positive one (job enrichment). As such:

$$E_b = JE_b - RS_b = (\alpha_0 - \beta_0) + (\alpha_1 - \beta_1)S - (\alpha_2 + \beta_2)S^2 \qquad (4)$$

$$E_f = JE_f - RS_f = (\alpha_0 - \beta_0 - \boldsymbol{\delta}) + (\alpha_1 - \beta_1 - \boldsymbol{\epsilon})S - (\alpha_2 + \beta_2 - \boldsymbol{\theta})S^2 \qquad (5)$$

with the additional assumption of $\alpha_1 > \beta_1 + \boldsymbol{\epsilon}$

The difference in the intercepts ($\boldsymbol{\delta}$) is not of direct interest. What matters, which gives rise to Hypotheses 1 and 2, are the differences in the linear and quadratic terms of service ratio. Specifically, the linear term of service ratio for front-end employees will be smaller by $\boldsymbol{\epsilon}$ compared to back-end, and the quadratic term will be larger (*i.e.*, less negative) by $\boldsymbol{\theta}$. These suggest a flatter inverted U-shaped relationship between the level of service infusion and satisfaction for front-end employees, when compared to the rest.

B. Satisfaction with other aspects of work

Table 4 presents the results for the other four, more specific, satisfaction measures. Regarding 'satisfaction with their salary and benefits', only back-end employees are affected during their employer's move toward higher levels of service infusion (Wald test-statistic: 7.06; $p < 0.05$). The within-firm effect, as hypothesized, is inverted-U shaped. The coefficients of the interaction terms involving the front-end dummy are strongly significant, and of signs suggesting a much flatter curve for this class of employees. This makes the overall effect very weak (Wald test-statistic: 1.16). Presumably, and given the significance of the coefficient of the front-end dummy (0.069; $p < 0.1$), this might be because front-end employees (especially salespeople) of pure-product firms generally receive higher salaries and their performance is tied to monetary bonuses, *i.e.*, before their employer starts its servitization journey (when service ratio = 0), they are already significantly happier with their pay than their back-end colleagues. Interestingly, the insignificant random slope coefficient suggests that there is no heterogeneity across manufacturers with respect to how the satisfaction of employees with this work aspect changes during service transition.

The results for senior leadership are very similar, with the exception that the variances of the random terms of service ratio are both significant ($p < .05$). This is not a surprising result. Leadership quality, managerial aptitude, and personnel management approaches vary

considerably across firms, constituting sources of competitive advantage (e.g., Petrick et al., 1999). Given how important these aspects are for successful service transition (e.g., Gebauer and Friedli, 2005), it is reasonable that employees of different manufacturers will be heterogeneously affected, depending on how competent, resourceful, and attentive, senior management is.

The within-firm relationships appear to be of an inverted-U shape for work-life balance and career opportunities, with the curves for front-end employees being flatter. However, it is worth noting that the total effects are weak and insignificant; if anything, there might be a weak linear within-firm effect of service infusion on the satisfaction of back-end employees only. Despite the weak 'average' effect though, work-life balance and career opportunities of individual employees are heterogeneously affected by changes in the level of their firm's service infusion, as evidenced by the large variances of the random service ratio terms.

Table 4 – Model results for the other satisfaction measures

VARIABLES	Compens. & Benefits (1)	Senior Leadership (2)	Work-life Balance (3)	Career Opportunities (4)
Front-end (Yes = 1)	0.0690*	-0.0471	-0.155**	0.00835
	(0.0401)	(0.0467)	(0.0741)	(0.0366)
Service ratio	1.801**	2.131**	1.254**	1.521*
	(0.713)	(0.892)	(0.625)	(0.781)
Service ratio^2	-1.537*	-2.311**	-0.914	-1.414
	(0.851)	(1.077)	(0.651)	(0.883)
Service ratio * Front-end	-1.076***	-0.451	-0.618	-0.291
	(0.397)	(0.440)	(0.431)	(0.477)
Service ratio^2 * Front-end	0.848***	0.0589	0.689**	0.230
	(0.303)	(0.346)	(0.330)	(0.328)
ROA (lagged)	0.304	0.581	-0.309	0.482
	(0.272)	(0.361)	(0.343)	(0.355)
ROA^2 (lagged)	0.471***	0.529***	-0.0435	0.590***
	(0.130)	(0.190)	(0.193)	(0.227)
Employees in 000s (ln)	0.0468	0.250***	0.0667	0.251***
	(0.0487)	(0.0779)	(0.0451)	(0.0560)
R&D Expenditure (lagged)	-3.75e-07	-3.13e-05**	-1.56e-05*	-2.42e-06
	(1.01e-05)	(1.33e-05)	(9.04e-06)	(1.05e-05)
Net profit margin (lagged)	-0.166***	-0.210	-0.0136	-0.188
	(0.0548)	(0.163)	(0.0968)	(0.169)
Var (Intercept)	0.138***	0.171***	0.127***	0.107***
	(0.0315)	(0.0487)	(0.0229)	(0.0312)
Var (Service ratio)	0.0727	4.366**	0.176***	2.907**
	(0.0740)	(1.904)	(0.0525)	(1.250)
Var (Service ratio^2)		4.679**		3.111*
		(1.935)		(1.610)
Cov (Service ratio, Service ratio^2)		-4.352**		-2.891**
		(1.878)		(1.402)
Cov (Service ratio, Intercept)	-0.0375	-0.576**	-0.0795***	-0.353**
	(0.0343)	(0.270)	(0.0281)	(0.174)
Cov (Service ratio^2, Intercept)		0.469*		0.298*
		(0.262)		(0.171)
Observations	19,522	20,196	19,926	20,001
Number of firms	197	198	196	197
Log-likelihood	-27277.09	-30821.61	-28996.83	-30116.72
Wald test for Back-end	7.06**	5.97*	4.18	3.81
Wald test for Front-end	1.16	3.79	1.92	1.87

Notes: Models (1) and (3) treat as random only the linear term of service ratio, since including its quadratic in the random part did not allow the model to converge. All models include a constant, industry and year dummies and the means of all explanatory variables. Robust (clustered by firm) standard errors to account for serial correlation in the idiosyncratic error term within firms are presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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Table 1: Sample summary statistics

Variables	Mean	Median	Std. dev.	Min.	Max.
Service ratio	.349	.262	.337	0	1
Overall rating*	3.3	3.35	.835	1	5
Compensation & benefits*	3.35	3.47	.716	1	5
Senior leadership*	2.91	3	.911	1	5
Work-life balance*	3.49	3.6	.806	1	5
Career Opportunities*	3.05	3	.83	1	5
ROA	.055	.059	.086	-3.7	.487
Employees (*in thousands)*	82.7	79.8	59.6	.025	642.2
R&D expend. (*in million $*)	2452.9	839	3382.6	0	1397
Net profit margin	.064	.07	.147	-10.31	1.93
N (firms)			201		
*N*t* (firm-year pairs)			1000		

Notes: * Employee-level outcomes have first been averaged at the firm-year level

Table 2: Distribution of overall rating by quintiles of service infusion

Overall Satisf.	Back-end				Front-end				Total (%)
	Low	Med	High	Total (%)	Low	Med	High	Total (%)	
1	6.2	4.87	10.38	6.83	7.24	6.88	12.51	10.13	7.67
2	9.89	11.56	14.14	12.33	12.11	10.26	13.66	13.4	12.6
3	25.19	26.47	25.72	25.69	21.97	27.91	23.73	25.46	25.53
4	38.45	38.59	27.71	35.55	36.22	37.05	19.51	29.17	33.93
5	20.26	18.51	22.04	19.6	22.45	17.9	30.59	21.83	20.17

Table 3: Model results for overall rating

VARIABLES	(1)	(2)	(3)	(4)
Front-end (Yes = 1)	-0.0154	0.0183	-0.0149	0.0181
	(0.0255)	(0.0488)	(0.0256)	(0.0495)
Service ratio	0.403	1.547*	1.123**	1.822**
	(0.335)	(0.801)	(0.525)	(0.835)
Service ratio^2	-0.481	-1.616**	-1.136	-1.859**
	(0.352)	(0.798)	(0.761)	(0.918)
Service ratio * Front-end		-0.369		-0.418
		(0.533)		(0.551)
Service ratio^2 * Front-end		0.209		0.304
		(0.501)		(0.525)
ROA (lagged)	0.587	0.638*	0.390	0.398
	(0.390)	(0.375)	(0.333)	(0.331)
ROA^2 (lagged)	0.592***	0.616***	0.535***	0.535***
	(0.204)	(0.206)	(0.181)	(0.178)
Employees in 000s (ln)	0.0559	0.105	0.181***	0.183***
	(0.0824)	(0.0657)	(0.0704)	(0.0692)
R&D Expenditure (lagged)	-8.33e-06	-1.06e-05	1.89e-06	1.32e-06
	(8.75e-06)	(7.83e-06)	(7.37e-06)	(7.42e-06)
Net profit margin (lagged)	-0.176	-0.177	-0.168	-0.168
	(0.159)	(0.161)	(0.154)	(0.154)
Var (Intercept)	0.153***	0.151***	0.146***	0.142***
	(0.0279)	(0.0280)	(0.0384)	(0.0368)
Var (Service ratio)			3.218**	2.689**
			(1.277)	(1.236)
Var (Service ratio^2)			3.438**	2.807*
			(1.410)	(1.464)
Cov (Service ratio, Service ratio^2)			-3.161**	-2.583**
			(1.302)	(1.298)
Cov (Service ratio, Intercept)			-0.418**	-0.367**
			(0.199)	(0.185)
Cov (Service ratio^2, Intercept)			0.328*	0.273
			(0.190)	(0.175)
Observations	21,869	21,869	21,869	21,869
Number of firms	201	201	201	201
Log-likelihood	-31556.581	-31543.348	-31507.52	-31504.596
McFadden's *pseudo-R^2*	0.0342	0.0345	0.0356	0.0357
Likelihood ratio test statistic	-	*Vs.* (1) 26.46***	*Vs.* (1) 98.12***	*Vs.* (3) 5.85

Notes:
All models include a constant, industry and year dummies and the means of all explanatory variables. Robust (clustered by firm) standard errors to account for serial correlation in the idiosyncratic error term within firms are presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
For Model (4): Wald stat. Internal = 4.89 (p-value = 0.087), Wald stat. Customer-facing = 2.34 (p-value = 0.31).

FIGURES

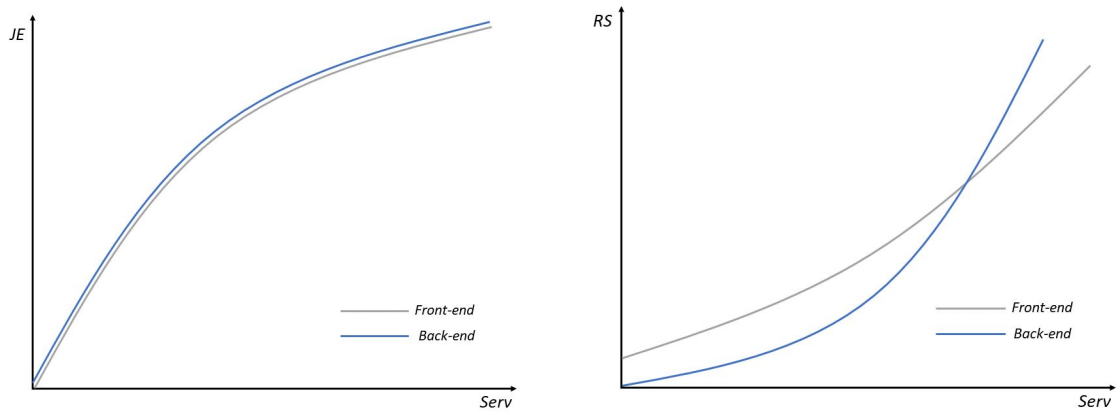


Figure 1 – The relationship between job enrichment (JE), role stress (RS) and service infusion (Serv) for front-end and back-end employees

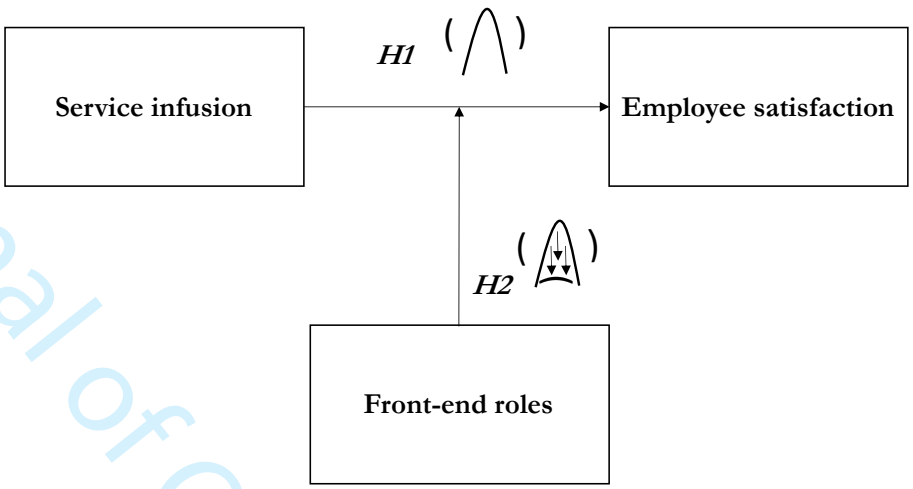


Figure 2 – Conceptual framework

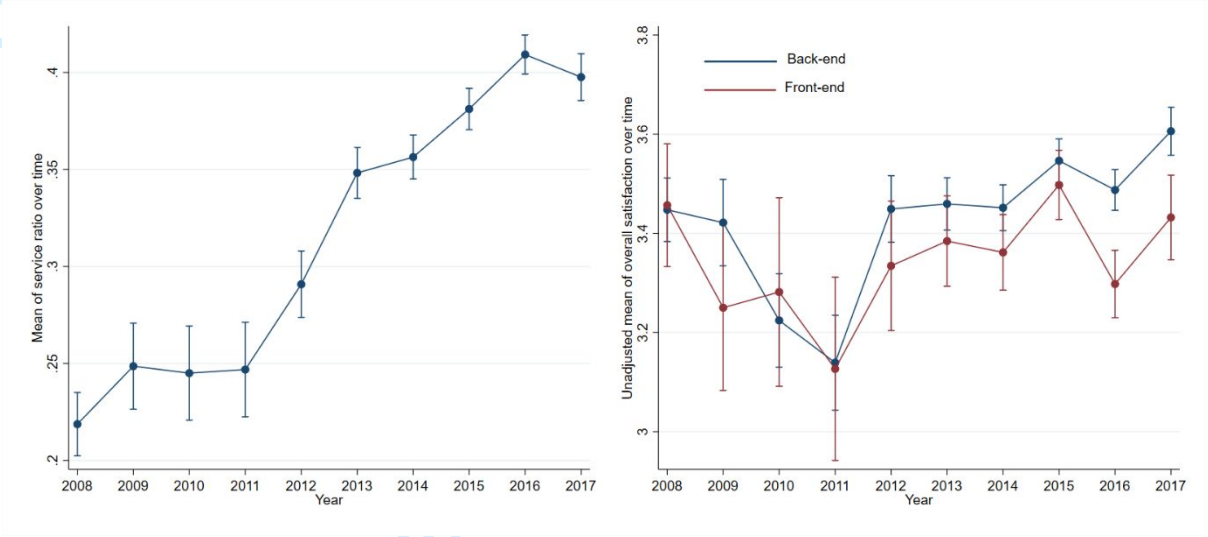


Figure 3 – Evolution of service infusion and employee satisfaction over the study timeframe (i.e., yearly means with 95% confidence intervals)

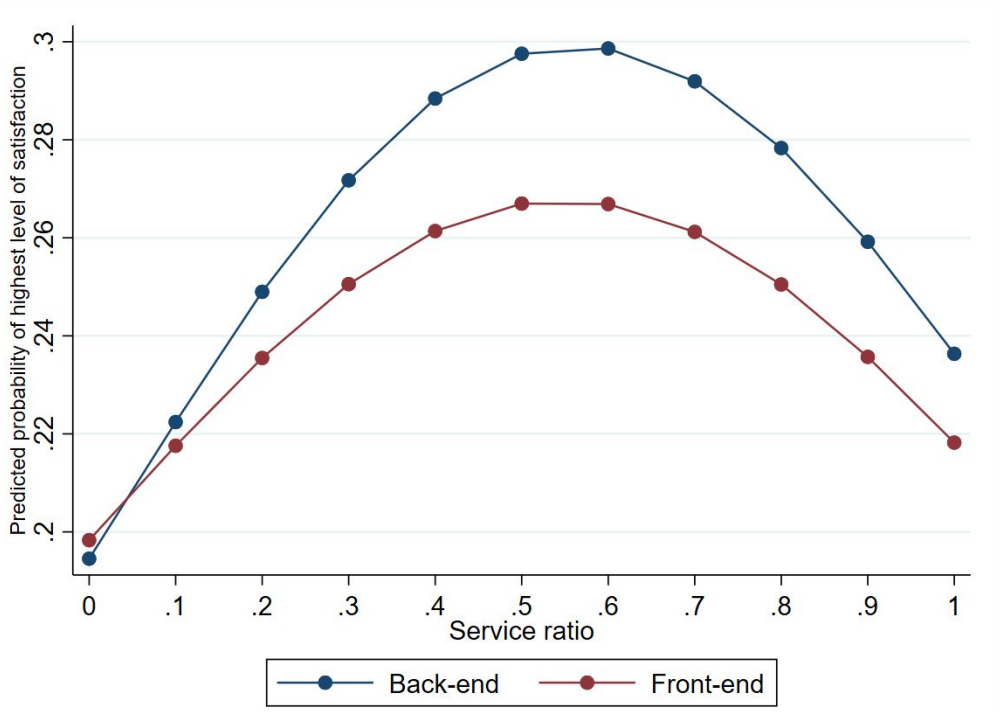


Figure 4 – The relationship between the level of service infusion and the probability of the highest satisfaction level

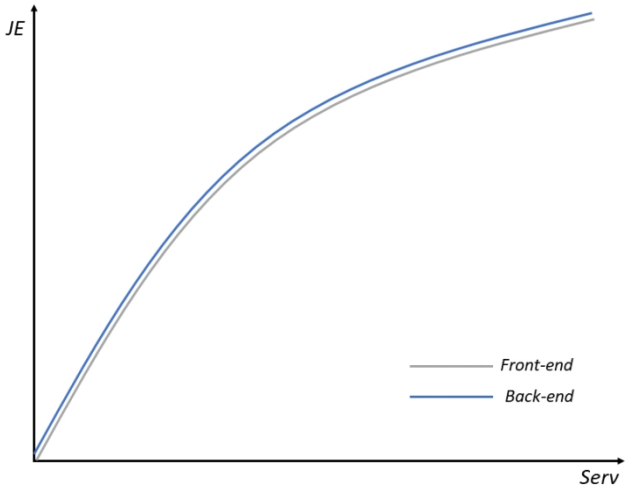


Figure 1a

855x481mm (38 x 38 DPI)

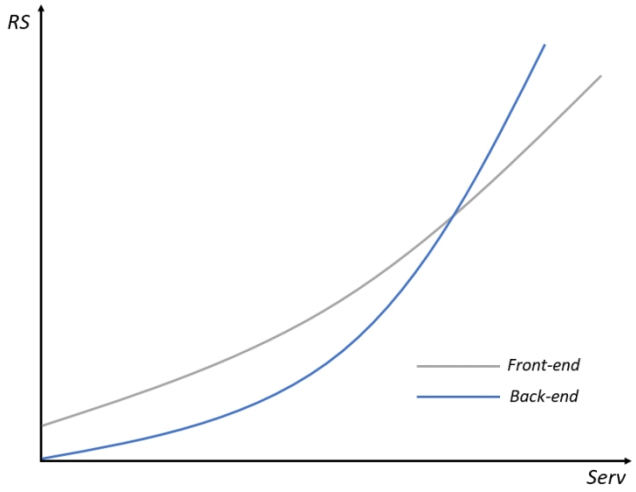
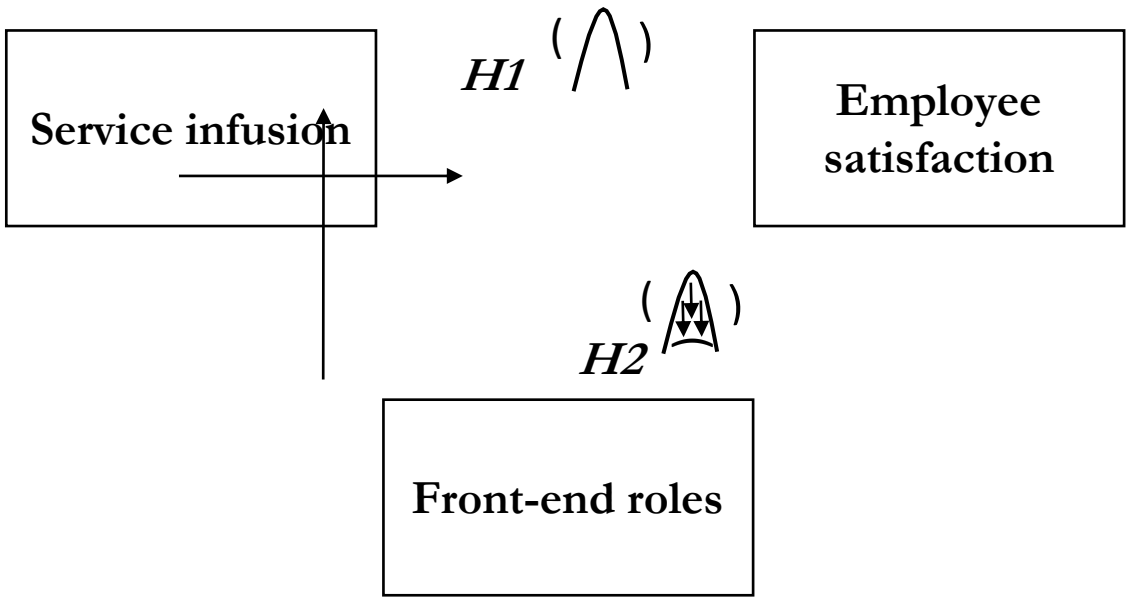


Figure 1b

855x481mm (38 x 38 DPI)


Service infusion
H1
Employee satisfaction
H2
Front-end roles

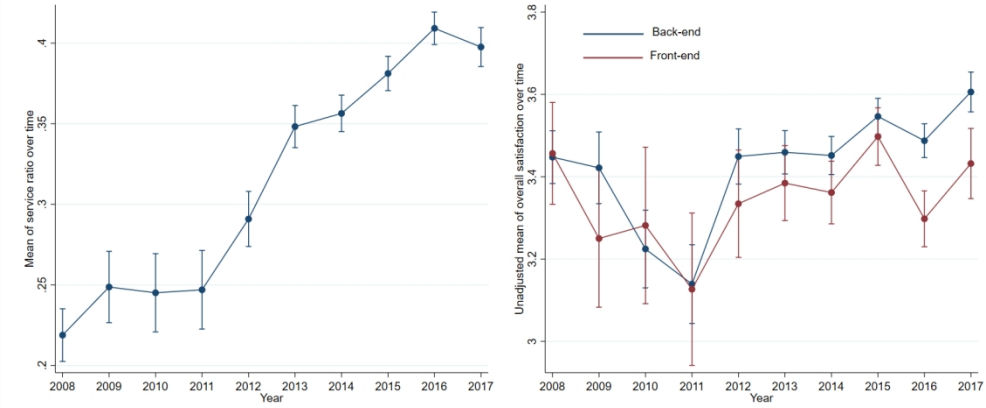


Figure 3

583x258mm (72 x 72 DPI)

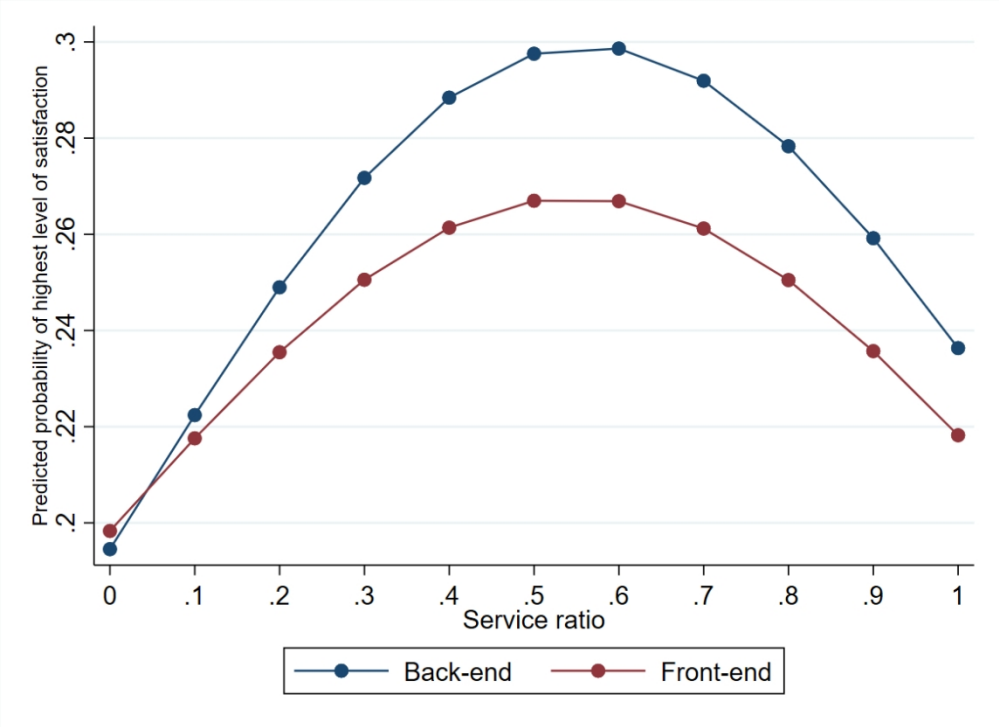


Figure 4

412x299mm (72 x 72 DPI)