Enablers of Industry 4.0 Technology Adoption:

Transformational Leadership and Emotional Intelligence

ABSTRACT

Many manufacturers are exploring the adoption of Industry 4.0-type technologies in their operations. Employee's contribution to high-tech initiatives is key to successful Industry 4.0 technology adoption. Few studies have explored the determinants of employee acceptance of Industry 4.0 technology adoption, including the role of their managers. Rooted in the unified theory of acceptance and use of technology model and social exchange theory, this abductive research follows an in-depth comparative case study approach. The two studied Dutch manufacturing firms engaged in the adoption of Industry 4.0 technologies in their primary processes, including cyber-physical systems and augmented reality. A mix of qualitative and quantitative methods was used, consisting of field visits, 14 semi-structured interviews with managers and frontline employees engaged in Industry 4.0 technology adoption, and the same participants filled in an exploratory questionnaire. The cross-case comparison introduces manager's need to adopt a transformational leadership style for employees to accept Industry 4.0 technology adoption. Secondly, manager's and employee's recognition and serving of their own and others' emotions through emotional intelligence are proposed as moderators to existing Industry 4.0 technology user acceptance theorizing. Synthesizing these insights with those from the domain of Organizational Behavior, propositions and a conceptual model were derived to "bring the manager back" into future Operations Management research.

Keywords:

Industry 4.0; unified theory of acceptance and use of technology; social exchange; job demands-resources; transformational leadership; emotional intelligence

INTRODUCTION

The promise of Industry 4.0-type technologies to boost operational excellence has received more-and-more scholarly and practitioner attention (Calabrese, Dora, Ghiron, & Tiburzi, in press-a; Liao, Deschamps, Loures, & Ramos, 2017; Tortorella, Giglio, & Van Dun, 2019). Industry 4.0 encompasses manufacturers' transformation of their production systems towards more smart and dynamic versions by adopting an ever-growing list of cyber-physical system technologies, thereby enabling new and more efficient customizable and connected processes, products, and services (Tortorella et al., 2019). Examples of such front- end technologies are: sensors, additive manufacturing, augmented reality, and rapid prototyping using 3D printing (Frank, Dalenogare, & Ayala, 2019; Tortorella et al., 2019), which are supported by base technologies, such as the Internet of Things (IoT), cloud, big data, and analytics, to enable vertical integration, horizontal integration, and end-to-end integration of organization with its supply chain (Chiarini & Kumar, in press). In its most radical form, digital networks of technologies enable high-end production with the minimal manual intervention (Wagire, Joshi, Rathore, & Jain, in press). As noted by Olsen and Tomlin (2020: 114), "much of the promise of Industry 4.0 is in the potential interactions and synergies between subsets of these technologies." The increasing attention for Industry 4.0 is mostly due to the need to overcome the inherent complexity in the implementation of such technologies (Hahn, 2020; Thoben, Wiesner, & Wuest, 2017). The transition towards Industry 4.0 may severely impact organizational structures and work routines (Calabrese et al., in press-a; Cimini, Boffelli, Lagorio, Kalchschmidt, & Pinto, in press). Most contemporary research focused on how Industry 4.0 practices can replace or be integrated into existing operational practices (Tortorella et al., 2019). Nonetheless, the proof of the pudding lies in employee's acceptance and (correct) usage of those high-investment technologies (Hahn, 2020), that may likely be a threat to their own job.

Venkatesh and Davis' (2000) extended Technology Acceptance Model (TAM2) describes the conditions under which individual employees may be persuaded to use new technologies. They later mapped TAM2 vis-à-vis competing acceptance models, resulting in the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003; Williams, Rana, & Dwivedi, 2015). Peculiarly absent from the UTAUT model is leadership. While there are accounts that (top) management support contributes to user adoption, leadership is rarely explicitly modelled into existing UTAUT theorizing (Neufeld, Dong, & Higgins, 2007). To further boost technology acceptance modeling, Venkatesh and Bala (2008) advised integrating leadership theory to enrich the conceptualization of management support.

The adoption of Industry 4.0-type of technologies is often linked to employee's job insecurity, especially those in low-skilled jobs (Cagliano, Canterino, Longoni, & Bartezzaghi, 2019). But that is not all: Employee's attitude towards Industry 4.0 technology adoption was shown to vary between traditional defiance or functional skepticism and approaching Industry 4.0 adoption in a more playful manner (Schneider & Sting, 2020). Hence, leaders' socio-emotional capabilities and sensitivity to individual differences are likely to be more important than before to tailor their approach to achieving employee's acceptance for Industry 4.0 adoption. As will be argued in the Theory section, various leadership styles have been associated with technology implementation before. This study therefore explores the role of leadership style in adopting Industry 4.0.

In addition, similar to Schroeder *et al.* (2005), we expect that manager's emotional intelligence (EI) can improve our theoretical understanding of Operations Management and in particular, Industry 4.0 adoption. EI is defined as the ability to recognize and regulate one's own and other's emotions (Wong & Law, 2002; Zeidner, Matthews, & Roberts, 2004). Manager's EI has been positively related to assembly line worker's performance (Vidyarthy, Anand, & Liden,

2014) and project success (Rezvani, Chang, Wiewiora, Ashkanasy, Jordan, & Zolin, 2016). People with high EI are deemed more capable of controlling negative emotions, including those related to job insecurity (Wong & Law, 2002; Zeidner et al., 2004). At the same time, managers with high EI may also be able to spot more easily the propensity of their employees to change and innovate (Zeidner et al., 2004), and may even stimulate employee's creativity (Rego, Sousa, Cunha, Correia, & Sair-Amaral, 2007). As such, leadership must be added to our current theoretical modelling of employee technology acceptance determinants. At work, leadership is typically associated with managers at various hierarchical ranks. Given that managers are the decision-makers and have power and authority to implement Industry 4.0 technologies, understanding employee's emotions throughout the implementation journey may help managers address any issues of job insecurity and resistance to change. They can also address the feelings of professional challenge, thereby enhancing employee's acceptance of Industry 4.0 technology. Therefore, in this study the following question is explored: *How do managers affect employee's acceptance of Industry 4.0 technology, and, in turn, Industry 4.0 technology adoption?*

Using a comparative case study approach and achieving data triangulation by adopting a mixed-methods design, the aim is to elaborate the theorizing as will be summarized in the next section. The merits of this type of abductive reasoning based on in-depth case analysis have been described before by Ketokivi and Choi (2014). After describing the empirical data collection procedure, the two case narratives, and the cross-case comparisons, manager's transformational leadership style emerged as an additional antecedent of employee's Industry 4.0 technology acceptance. Thus, in the Discussion section, additional theory is synthesized to develop propositions. The resulting conceptual model is meant to inspire practically relevant future empirical studies on the edge of Organizational Behavior, Change Management, and Operations Management.

LITERATURE REVIEW

Below the literature pertaining to the enablers of employee's acceptance of Industry 4.0 adoption is reviewed, including the underlying UTAUT and Social Exchange theories.

Industry 4.0 Adoption and Employee's Acceptance

Industry 4.0 is assumed to have major implications on the work organization (Cagliano et al., 2019). Still, recent reviews on manufacturer's adoption of Industry 4.0 did not highlight the role of employees in the effective adoption of Industry 4.0, even though Industry 4.0 adoption is likely to lead to employee reorganization and requires certain skills (Calabrese, Levialdi Ghiron, & Tiburzi, in press-b; Srinivasan, Kumar, & Narayanan, 2020). One of the barriers for Industry 4.0 may be 'internal resistance to organizational changes' (Calabrese et al., in press-a; Da Silva, Kovaleski, Pagani, Silva, & Corsi, 2020) as it challenges employees to relinquish the status quo in preparedness for reskilling or upskilling, apart from the financial and technological challenges (Liboni, Cezarino, Jabbour, Oliveira, & Stefanelli, 2018; Srinivasan et al., 2020). Thus, as underlined by Olsen and Tomlin (2020: 118), studying the acceptance of Industry 4.0 type technologies, such as robotics, "seem like a natural line of inquiry for the OM field".

One of the existing theories regarding employee's acceptance of technology in the workplace is the extended *Technology Acceptance Model* (TAM2), coined by Venkatesh and Davis (2000). The original TAM demonstrates three important factors that influence one's usage of new technology, namely: perceived ease of use, perceived usefulness, and intention to use (Davis, Bagozzi, & Warshaw, 1989). This model is strongly built upon the theory of reasoned action (Fishbein & Ajzen, 1975). The extended TAM (labelled as 'TAM2') adds social influence processes (e.g., subjective norm, the voluntariness of technology usage, and image) and cognitive processes (job relevance, output quality, result demonstrability, and perceived ease of use) (Venkatesh & Davis, 2000). The integrated TAM model (i.e., 'TAM3') then further reduced so

called ‘crossover effects’ between the various antecedents of behavioral intention (Venkatesh & Bala, 2008), while adding to the determinants of perceived ease of use (based on Venkatesh, 2000).

In an effort to synthesize the aforementioned and other existing models related to technology acceptance, the *UTAUT model* was introduced (Venkatesh et al., 2003; Williams et al., 2015). UTAUT distinguishes four antecedents of people’s intention to adopt technology, and, in turn, usage behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions (Williams et al., 2015). In the UTAUT model, people are more likely to embrace technology when they have a reasonable expectation that using the technology: 1) will lead to favorable results; 2) will not cost too much of their effort; 3) will be supported by others; and 4) will have enough resources and guidance for implementation. Hence, having a supportive environment for innovation is key. In fact, this is in line with the main tenets of employee innovation literature, according to which a psychological climate for innovation must exist for employee’s innovative work behavior to occur (Scott & Bruce, 1994). Innovative work behavior is defined as the generation, promotion, and implementation of innovative ideas (Scott & Bruce, 1994). In this sense, leadership is crucial in enabling creating such a psychological climate for innovation (Anderson, Potočnik, & Zhou, 2014).

Nonetheless, the different versions of UTAUT nebulously identify the role of managers in positively influencing the worker’s acceptability towards technological adoption (Vidyarthy et al., 2014). In particular, the UTAUT model failed to account for how to deal well with employee’s emotions and how it affects the adoption and acceptance of new practices by employees. This is especially the case when those practices may affect job or even status loss. This study, therefore, explores how managers can effectively facilitate the Industry 4.0 adoption process.

The Role of Leadership in Employee's Acceptance of Industry 4.0 Adoption

Leadership support towards digital transformation activities has been ranked as one of the key criteria for a firm to mature its Industry 4.0 adoption (Wagire et al., in press). As noted by Da Silva *et al.* (2020: 12), the role of "leadership will be instrumental in conducting [Industry 4.0] changes in the company" as Industry 4.0 adoption affects both the organizational structure and culture. The plethora of publications on effective leadership in the past decades of increasing industrialization dealt with a wide variety of leadership theories (Lord, Day, Zaccaro, Avolio, & Eagly, 2017). As will be argued below, among the most prevalent ones are leader-member exchange, transactional leadership, transformational leadership, and shared leadership (Lord et al., 2017).

Venkatesh and Bala (2008) coined leader-member exchange theory as a potential angle to better understand the impact of management support on information technology adoption. Leader-member exchange proposes that the quality of the dyadic relationship between managers and their subordinates differs per individual, and, as such, managers have a different impact on different employees (Lord et al., 2017). Such dyadic differences have indeed been found, based on cross-sectional survey data, to impact TAM's perceived usefulness variable (Magni & Pennarola, 2008). Yet another cross-sectional survey study, by Schepers, Wetzels, and De Ruyter (2005), found that transactional leadership did not relate to service agent's technology acceptance, while transformational leadership was found to be positively associated with the technology's perceived usefulness. Transformational leadership primarily consist of four sub-dimensions, namely manager's provision of: idealized influence (i.e., charisma), inspirational motivation, intellectual stimulation, and individualized consideration (Bednall, Rafferty, Shipton, Sanders, & Jackson, 2018; Peng, Li, Wang, & Lin, in press). Schepers et al. (2005) noticed that especially the intellectual stimulation sub-dimension might boost employee's perception of the

usefulness of technology at work by encouraging their imagination and innovative thinking. Still, Schepers et al. (2005: 505) also called for the investigation of "other leadership theories and constructs (e.g. leader characteristics) to TAM". Finally, Yammarino (2013) proposed that a more collectivistic, shared leadership style would best fit the typically flat organizational structures of technology-driven organizations. The review highlighted the lack of conclusive evidence on how different leadership styles impact employee's Industry 4.0 technology adoption. Thus, this study explores the role of leadership more broadly to provide more direction for future studies on this topic.

On top of that, this study incorporates the role of the manager's emotional intelligence (EI). This is because EI is expected to play a decisive role in the extent to which managers are sensitive to and act upon employee's feelings vis-à-vis the desired change (Harlan, 2020). Change recipients' acceptance, resistance, disengagement, or proactivity to the (radical) change is an inherently affective process (Oreg, Bartunek, Lee, & Do, 2018) that have an important impact on the smoothness and success of the Industry 4.0 implementation process. Organizational Behavior literature distinguishes both 'ability-based' and 'mixed-based' EI, where the first "pertains to the recognition and control of personal emotion" and the latter mixes EI traits with abilities (Joseph & Newman, 2010: 55). Most scholars deem ability-based EI more scientifically rigorous because it is based on measurable sub-dimensions (Joseph & Newman, 2010). A popular operationalization of ability-based EI has four sub-dimensions: appraisal and expression of emotion in the self, and in others, regulation of emotion in the self, and use of emotions (Wong & Law, 2002).

Manager's EI has been positively related to employee's innovative work behavior (Zhou & George, 2003). Another documented example of the positive effects of manager's EI on employee's job performance constitutes Vidyarthy *et al.*'s (2014) study among 381 assembly line

workers and their 88 direct supervisors. Another evidence shows that the high EI-level of high-tech project managers in the Australian defence industry contributed to project success (Rezvani et al., 2016). One of the explaining mechanisms for these effects stems from the *Social Exchange theory* "which describes the exchange of socio-emotional resources between leaders and followers" (Rezvani et al., 2016). Following this theory, "employees who perceive supportive relationships with the organization [e.g., feeling understood by their managers] have favorable attitudes and engage in positive extra-role behaviors that help it to succeed [e.g., contribute to the adoption of Industry 4.0 in their organization]" (Gibney, Zagenczyk, & Masters, 2009: 666).

Beyond the manager's EI, employee's level of EI is also explored in the change towards Industry 4.0 adoption. Oreg et al. (2018) argued that employee's change coping potential might help them control their responses to change. EI is considered a coping mechanism that can help employees facilitate adaptation and embrace change instead of resisting it (Huy, 1999; Wiens & Rowell, 2018). Employee's coping potential may be activated by social support and perceived control of the change (Oreg et al., 2018). The conclusion derived from the summarized literature leads us to empirically examine the assumption that leadership may relate to employee's acceptance of Industry 4.0 technology, and consequently, their actual usage of the Industry 4.0 technology.

METHODOLOGY

Research Design

Comparative case studies with two firms leading Industry 4.0 technologies implementation was adopted. We used multiple qualitative methods, including site visits, interviews, whereby quantitative questionnaire data is used to support the qualitative findings. In such a mixed-method approach, different types of observations are collected and integrated to permit more complete and synergistic data utilization (Fetters, Curry, & Creswell, 2013). By

associating quantitative and qualitative data collection and analysis, it is, in fact, possible to better explain the phenomena under consideration through a process of triangulation (Dooley, 2009; Edmondson & McManus, 2007). This process, whereby complementary perspectives are combined, increases the external validity and construct validity (Dooley, 2009; Edmondson & McManus, 2007). Consequently, a mixed-method methodology can expand and strengthen the theoretical and practical implications, thus answering the research question in a more rigorous way (Johnson, Onwuegbuzie, & Turner, 2007). This approach fits the abductive nature of the present study.

Sampling and Sample Description

A theoretical sampling strategy was followed (Barratt, Choi, & Li, 2011). To answer our research question, we had identified companies that implemented Industry 4.0 technologies on their work floor, thus involving frontline employees. The database of the 2,200 firms that were members of the largest employer association for the Dutch technology industry was utilized to select the cases. Their members are accountable for a sixth of the Netherlands total export earnings. All 60 firms labelled in the database as ‘Industry 4.0 ambassadors’ were invited via e-mail, with one reminder, to participate in the study. After 31 firms had replied positively, telephonic interviews were conducted with their senior managers to examine each firm’s eligibility. The main selection criterion was the company engagement in actively implementing Industry 4.0 technologies in their daily operations. The premises of 12 of those 31 firms were then visited to further assess the level of Industry 4.0 adoption within their firm. During those visits, interviews were held with key informants and each factory was toured. Eight firms were excluded because their Industry 4.0 initiative was in a very nascent stage or had not yet started. Although originally the ideal number of four cases were selected for this study (Barratt et al., 2011), two other firms opted out at the last minute because they could not participate due to other

priorities. All in all, two manufacturing firms were selected and agreed to participate in the study.

The two sampled firms were considered large-sized, with 250 and 700 employees, respectively, and existed for more than 45 years (see, Table 1). The two multinational firms worked in different, non-competing industries: One produced metalworking machinery, whereas the other was engaged in design and engineering. Both firms actively worked with smart intuitive machine operations, multi-system integration, innovative technologies, and integrated production lines with flexible productions. In addition, both firms had a history of adopting new technologies, including recently implemented Enterprise Resource Planning packages, without laying off people. The case studies focused on the introduction of two particular Industry 4.0 technologies: The first firm adopted a large autonomous robot called “Fabricator”. Firm number two integrated augmented reality in its design process using the “Microsoft HoloLens”. Table 1 summarizes the company characteristics.

Insert Table 1 about here

The participants involved managers responsible for implementing Industry 4.0 technologies in their production lines and their employees working directly with Industry 4.0 technologies. All managers had leadership responsibilities. The participants’ job positions ranged from the operations manager or production manager to technical advisor and technical maintenance engineer. In terms of demographics: all respondents were male, on average 31-40 years old and holding a Bachelor’s degree. Most of them held their current job position between 4-8 years (employees) and 9-12 years (managers). These demographics were equally distributed among both cases, enabling the cross-case comparison. Furthermore, following the university’s ethical committee’s approval for this study, each participant signed an informed consent form and individually agreed to participate in the study.

Qualitative Data-collection

Both cases were visited multiple times. During those site visits, the work floor was toured to observe the focal Industry 4.0 technologies' application in real-time. This enabled the researchers to gain first-hand insight into the workings and verify the level of Industry 4.0 integration in the operator's daily work (Voss, Tsikriktsis, & Frohlich, 2002). The participant observation and informal conversations during these shop-floor visits also helped create trust and understanding between the researcher and the respondents. This enabled creating a safe climate required to discuss also more sensitive, affective elements of the Industry 4.0 implementation process (Yin, 2011).

Furthermore, 14 one-hour interviews were held with eight employees and six managers in both companies (see Table 1). Pilot interviews with Industry 4.0 experts from similar companies were performed after which the semi-structured interview guide (Appendix A) was finalized. This interview guide included both open-ended questions and the critical incidents technique (CIT) (Flanagan, 1954). This interview technique enables detailed and structured exploration of people's behavior in key situations (Bott & Tourish, 2016; Flanagan, 1954). CIT encompasses asking for those key moments and then probing through follow-up questions (Bott & Tourish, 2016). As noted by Bott and Tourish (2016: 276): "CIT potentially offers the kind of 'thick description' that is particularly useful in theory building". It is thus a suitable interview method fitting the exploratory nature of our study. Example questions are: "What change has the company experienced regarding Industry 4.0 adoption?", "Why were those radical technological changes implemented?", "How did the managers communicate about these changes?" and "How did this change affect your job or you personally?". All interviews were audio recorded and then transcribed verbatim.

Survey Measures

In both companies, frontline employees and their managers (*N*=20) filled out a survey consisting of the following scales: The *level of Industry 4.0 technology adoption* was measured using the five-item "process-related technologies" scale (Tortorella et al., 2019), on a seven-point Likert scale: 1 = technology is not used to 7 = technology is fully adopted. An example item is: "Digital automation with process control sensors".

Venkatesh and Davis' (2000) survey was used to measure the various facets of employee's acceptance of Industry 4.0 technology. This survey operationalized all UTAUT sub-dimensions: "perceived usefulness" (*performance expectancy*, four items, e.g., "Using the system enhances my effectiveness in my job"), "perceived ease of use" (*effort expectancy*, four items, e.g., "I find the system to be easy to use"), "subjective norm" (*social influence*, two items, e.g., "People who are important to me think that I should use the system"), and "intention to use" (*behavioral intention*, two items, e.g., "Assuming I have access to the system, I intend to use it). To measure the dimension *facilitating conditions* we took a composite measure of employee's "perceived support for innovation" of both the five-item "managerial support" and three-item "organizational support" scales (Lukes & Stephan, 2017). An example item is: "Our organization has set aside sufficient resources to support the implementation of new ideas". All scales were measured on a seven-point Likert scale: 1 = fully disagree to 7 = fully agree.

Managers and employees rated their own *EI* using Wong and Law's (2002) scale which distinguishes the following four-item sub scales: self-emotion appraisal (e.g., "I have a good understanding of my own emotions"), other's emotion appraisal (e.g., "I am sensitive to the feelings and emotions of others"), regulation of emotion (e.g., "I am able to control my temper and handle difficulties rationally"), and use of emotion (e.g., "I would always encourage myself to try my best"). The total EI scale includes 16 items, on a seven-point Likert scale: 1 = fully disagree to 7 = fully agree.

The survey also gathered the respondent's gender, work experience, and educational level; cognitive ability might affect people's ability to understand emotions (Joseph & Newman, 2010). Finally, "voluntariness of use" of Industry 4.0 technologies was measured, using three items, as this is a key moderator in the UTAUT model (Venkatesh et al., 2003). An example item is: "My supervisor does not require me to use the system".

Data Analysis

The interview transcriptions were content analyzed by two Master students in ATLAS.ti, following Strauss and Corbin's (2002) open, axial, and selective coding phases (Ketokivi & Choi, 2014). After the initial screening of the transcriptions using open coding, codes were developed that corresponded with partially theory-based (sub) dimensions. As mentioned by Grodal, Anteby, and Holm (in press: 13), in qualitative data analysis "past research serves as a springboard for asking questions to spur new lines of research". Figure 1 illustrates the three coding phases. One of the authors contributed to the code-development process and double-checked their coding. To illustrate, the manager's EI was coded when managers described their own emotions (i.e., a sign of self-emotion appraisal) or the emotions of their employees (i.e., other's emotion appraisal). Within the employee interviews, we coded the manager's EI when they mentioned the manager's handling of own or other's emotions. The same procedure was followed for the other variables.

Finally, the survey data was analyzed using simple statistics: Cronbach's alpha's and means per case. The survey data were used as a method to add validity to the findings reported from the qualitative case studies. We acknowledge the limitations of the smaller sample size in the survey study and thereby treat the conclusions of the survey cautiously.

Insert Figure 1 about here

The various data sources—the coded interview transcriptions, exploratory survey data, as well as our experiences during the field visits—were then integrated into two case narratives, that followed a "weaving approach" to link the qualitative and quantitative findings (Fetters et al., 2013: 2142). These detailed case write-ups helped compare and contrast the emerging patterns (Barratt et al., 2011).

RESULTS

This section first reports both cases and then synthesizes the cross-case findings.

Fabricator Case

The Fabricator introduction was prepared over multiple years and aimed at enabling a more efficient production system. The Fabricator constitutes a full-automatic robot, which autonomously calculates the slopes/angles and then welds pre-assembled parts into a final product based on customer-tailored 3D models that are fed into the system by operators. The robot had been placed immediately after a fully automatic production line that prepared the separate parts by sawing and drilling them. The Fabricator replaced a set of machines previously operated by frontline workers, who became responsible for operating the Fabricator instead and keeping in contact with software programmers to optimize the Fabricator's settings. The operations manager proudly stated: *"There is nothing better than this. (…) This is smart industry."* He continued by providing his vision on the Fabricator's importance in enabling the firm to stay ahead of their competitors, by upscaling their production capacity, delivering a constant quality level, while dealing with an increasingly tight labor market for highly skilled operators.

The Fabricator's adoption was a gradual process: First, managers had selected and stimulated several operators to be involved in earlier stages of the development; they personally invited them during face-to-face meetings. An initial version of the Fabricator was developed at a

neighboring company's facilities specializing in developing such high-tech machines. Before its introduction, a wider group of managers and employees participated in a factory tour and various demos. An operator recalled: *"We were informed about the machine, its precise workings, and we saw it in action."* The training enabled operators to work with the new machine, boosting the perceived ease of use (μ = 5.84; Table 2). These are examples of moderate support for innovation that was felt (μ = 3.56).

Insert Table 2 about here

Another way employees were involved was during the director's annual presentation of the yearly objectives and financial results. Afterwards, there was a drinks session where all employees could ask questions to the director. The manager confirmed that he took the employees' voice and feelings seriously: *"Before we start using such a new machine, we always sit with the guys."* In more practical terms, he stated that when workers voiced concerns of (future) job loss due to the Fabricator, he would repeat that this was not the goal and, instead, *"we want to increase output and revenue with the Fabricator working alongside our people".* One of the operators noted that management was sensitive about employee's feelings and provided individual consideration: *"When I walk around all day with bad temper, they [management] notice."* Indeed, the manager's EI averaged 5.71 (Table 2). While using the Fabricator in daily work was not felt as entirely voluntary by some (μ = 3.44), people were overall positive about the Fabricator. Their scores for intention to use and actual adoption were relatively high in Table 2: 5.69 and 6.00, respectively. Besides the manager's individualized consideration, these positive feelings also stemmed from the fact that the Fabricator's high-tech possibilities enthused operators.

Although some employees noticed that other peers initially feared job loss, the

interviewed operators did not perceive such insecurities and were able to control their emotions. One operator noted: *"I knew everything would be fine."* Indeed, the employees who filled out the survey indicated a moderately high level of own emotional intelligence (μ = 5.40). We noted that professional challenge feelings prevailed; one of the operators stated: "*The Fabricator immediately appealed to me. I liked the challenge. Good that they build such a smart machine."* One of the frontline supervisors noted that employees understood the necessity for innovation: *"It is of course the firm's future and the future of the firm also is the future of your colleagues"*. The operations manager noted that the Industry 4.0 technology instilled a sense of pride among employees: *"When I ask employees in the hallway what they think of it, I feel they are quite proud of being able to work with the Fabricator. They do no longer see it as a threat, it is really like 'We are* [Firm name] *and we already work with the Fabricator, ahead of our competitors'."*

In sum, the Industry 4.0 adoption was supported by managers' clear vision and serious attention for people's sentiment, supporting innovation through employee training and their opportunity to voice opinions. This enabled employees to overcome any fears of job loss and embrace the Industry 4.0 adoption opportunities.

HoloLens Case

The HoloLens constituted a pair of augmented reality glasses that, together with a tailored software application integrating spatial mapping and holograms, enables both design engineers and sales agents to portray the firm's products at the customer's location. In addition, maintenance engineers can remotely check a machine's settings or status and immediately fill out the maintenance form. As such, the HoloLens supports customers' decision-making and a more efficient design and maintenance process. The operations manager explained the firm's vision: *"Through the HoloLens we expected to speed up certain processes that were initially based on paper files or opening a laptop."* As such, management's intention to adopt the HoloLens was to

replace bureaucratic processes with high-tech ones, which they expected to be an attractive feature for new hires: *"Instead of dull paperwork, you get interesting goggles to execute your job in a futuristic way"*.

The technology was piloted into the firm as part of a student's internship, to gradually move away from the traditional production approach in their sector towards more high-end customer service and attract new customers and employees. Meanwhile, also the need for internal efficiency drove the adoption of the HoloLens, as noted by one of the operational managers: *"Through these glasses we try to force them a bit to work with the system and optimize the processes. Well, it is a bit pushing them to work in a standardized and efficient way. (…) You hope to stimulate multi-tasking, and thereby the speed of work."*

In terms of support for the implementation, the management invested in a scrum team of six people from different departments that worked with the intern in a series of two-week sprints to test and implement the HoloLens in other work areas. To convince people to participate, the operations manager held individual face-to-face meetings with selected employees to invite them into the scrum team. One of the in-company technical advisors illustrated the high perceived support for innovation (μ = 5.79, Table 2) as follows: *"I think it is positive that they provide energy and resources to do it. This way we can move forward, we have to."* A maintenance engineer appreciated getting the opportunity to be a part of the scrum team. None of the employees felt a threat to their job because of the introduction of Industry 4.0 technology. This may have also been supported by their moderately high emotional intelligence level (μ = 5.27). One of the technical advisors illustrated employees' relatively rational way of regulating their response to change: *"the first response* [to changes at work] *is to let it sink in and think about the underlying reasons for change."*

During the interview, the manager showed awareness of employee's feelings vis-à-vis the

change by openly reflecting upon the initial resistance the HoloLens had caused among employees; he noted: *"It really struck me that there were a couple of people who resisted the plans directly. (…) Apparently more energy was needed to enthuse people for the product."* He explained that some felt that Industry 4.0 technology *"did not fit the company"*. Perhaps consequently, they chose a more gradual implementation strategy. Employees perceived that after some time, the enthusiasm was shared and picked up by the managers during the regular scrum meetings, as noted by the project coordinator. This was corroborated by the survey-based manager EI score.

While the management had experienced some resistance, the employees perceived its usefulness as very high (μ = 6.33), although the ease of use was not optimal (μ = 4.92, Table 2). One of the maintenance engineers illustrated this as follows: *"Well, it is kind of a big unit on your head, but if it would be a little bit smaller (…) you can work much faster, you save time and are less likely to forget something or make mistakes."* The project coordinator stated: *"While wearing the glasses they* [maintenance engineers] *can move through the workspace, stand next to the machine, do all the checks. By making gestures and saying things like 'OK' they can fill out the maintenance forms. (…) Normally we used to do that on paper or a laptop. This is of course much easier. And more fun!".* And perhaps also because employees did not feel forced to use the Industry 4.0 technology (μ = 6.00, Table 2), people's intention to use it was relatively high (μ = 5.50, Table 2). The score for actual adoption was lower as the management had chosen a bottom-up approach and had not dictated the use of the HoloLens in daily work. In reflection, one of the managers noted: *"We are now at the point of: what is the next step? (…) We have tried to plant a seed and enthuse people. (…) It is now up to the department maintenance engineering to integrate the HoloLens."*

In sum, management's gradual way of introducing and testing the HoloLens (both a sign

of manager EI and support for innovation) has allowed employees to overcome their initial skepticism and lend their support for the Industry 4.0 technology.

Cross-case Comparison

In comparing both cases, making their business future proof was the main reason both companies adopted Industry 4.0 technologies. In addition, management also talked about its (potential) efficiency effects. In both firms, employee's intention to use and actual Industry 4.0 adoption was relatively high. Instead of fearing job losses, employees mainly stressed the positive job challenges they experienced. Nevertheless, the different UTAUT dimensions were perceived differently between both cases, whilst potential moderating variables such as age, gender and work experience had similar values. Both manager's and employee's level of EI has potentially made up for this, resulting in relatively strong support from employees for both Industry 4.0 technologies. Manager's EI, for instance, would enable them to tailor their implementation approach. In the Fabricator case, they followed a top-down approach. Management informed staff about its introduction, personally invited a couple of volunteers to develop it further, and organized well-appreciated training. In terms of the HoloLens case, the managers changed their implementation approach into a more gradual bottom-up one, giving more freedom to its employees. This was meant to minimize the initial resistance to change, empower employees to embrace and lead the change. On top of managers' EI, we also noticed the importance of their leadership style that was characterized especially by a strong vision, consideration for employee's views, and providing a challenge to employees in working with these high-end technologies.

DISCUSSION

Using mixed-methods comparative case studies, we explored how managers affect employee's acceptance of the adoption of Industry 4.0 technologies, and, in turn, Industry 4.0 technology adoption. Although both employee's intention to use the technologies and the actual

adoption levels were relatively high in the two studied cases, the generally accepted conditions summarized in the UTAUT model scored differently across both cases and were thus not the sole predictors of employee's intentions. The findings point to a potential moderating effect of manager's and employee's EI on the relation between the four UTAUT core constructs and employee's intention to use Industry 4.0 technologies in their jobs. In addition, the managers' leadership closely resembled the transformational leadership style in both cases, which is thus proposed as an important antecedent of Industry 4.0 adoption. The rationale behind the propositions is expanded below.

Firstly, the findings answer the more general call for integrating how to deal with employee's emotions in management research (Ashkanasy, Humphrey, & Huy, 2017). Employee's own EI has been suggested to moderate the relationship between perceived job insecurity and aspects such as organizational commitment and dealing with job-related tensions (Zeidner et al., 2004). High EI managers have been associated with generating "excitement, enthusiasm and optimism in the work environment" and can anticipate and soften employee's initial negative responses to change (Zeidner et al., 2004: 387). Manager's EI can thus strengthen the part of the UTAUT model grounded in the Motivational theory, which states that extrinsic motivation can reinforce user's willingness to perform an activity (Venkatesh et al., 2003). Thus, their direct supervisor's support may propel the impact of existing determinants of employee's (extrinsic) motivations to embrace drastic changes in their daily work. Specifically, this motivation-strengthening effect of manager's EI may occur when managers appraise, recognize, and regulate their subordinate's initial skeptical feelings regarding the expected performance increase after adopting the technology vis-à-vis their effort put into learning how to work with the technology. High EI managers may elevate employee's beliefs that their management supports them and views that the available resources will be adjusted to their needs.

In their recent review, Williams et al. (2015) called for the "consideration of moderating variables" in future studies involving the UTAUT model. Building upon the earlier mentioned *Social Exchange theory* (Cropanzano, Anthony, Daniels, & Hall, 2017; Rezvani et al., 2016), we expect the moderating effects of manager's EI to play out primarily in the softer side of the model, in terms of the effects of social influence on employee's intention to accept the new technology. Social Exchange theory posits that employees are more inclined to reciprocate supportive behaviors of their bosses or coworkers (Cropanzano et al., 2017). EI-induced supportive relationships are seen to contribute to, for instance, employee's extra-role behaviors such as working on high-tech change projects (Rezvani et al., 2016). Manager's additional support, provided through spotting and acting upon employee's true feelings vis-à-vis the Industry 4.0 adoption, i.e., their emotional intelligence, is thus expected to intensify further the effect subjective norms have on people's user intention. Employees will likely take the subjective norms (i.e., social influence) more seriously and act upon them when treated with such care. Vice versa, when managers display a lower level of EI, this may reduce the effects of perceived social norms to use the focal technology. As such, Social Exchange theory can help explain the socio-emotional sides of technological transformation. On the contrary, the moderating effects of manager's EI is expected to be much weaker for the other three antecedents of people's intention to adopt Industry 4.0 technology, namely, performance expectancy (i.e., perceived usefulness), effort expectancy (i.e., perceived ease of use), or facilitating conditions such as the availability of organizational resources for innovation (i.e., perceived support for innovation). Thus, to support the future testing of this moderating effect, the following proposition was formulated with manager's EI as a potential new moderator of the relationship between social influence and employee intention to use Industry 4.0 technologies (see also Figure 2 for our conceptual model):

Proposition 1. Manager's emotional intelligence moderates the relationship between

employee's perception of being supported by others (i.e., social influence) and their intention to use Industry 4.0 technologies, ultimately leading to Industry 4.0 technology adoption.

Insert Figure 2 about here

Building upon *Job Demands-Resources theory*, employees own EI entails a personal level, psychological resource to accomplish work goals (Lee, Rocco, & Shuck, 2020; Schaufeli & Taris, 2014). Job Demands-Resources theory states that demanding job characteristics—e.g., in this case, the need to change towards Industry 4.0 radically—must be balanced by job or personal resources to avoid potentially negative psychological employee outcomes, and strengthen employee's work engagement (Schaufeli & Taris, 2014). EI can help employees deal with job demands such as high levels of perceived social pressure—or absence of social support—to comply with adopting the new technology (Venkatesh et al., 2003). EI can also enable employees to sense the various, albeit sometimes implicit, ways in which their managers or coworkers communicate about the norms to adopt the new technology. In both cases studied herein, managers kindly invited, and not summoned, employees to participate in the Industry 4.0 adoption (pilot) projects. The high-EI employees understood that their participation could lead to social status gain; indeed, both projects turned out to be showcase projects within the organization that led them into the new Industry 4.0 era. Employee's EI levels helped them foresee the merits of adopting Industry 4.0, beyond initially perceived job loss risks. Hence, beyond the theories identified during our initial literature review stage, Job Demands-Resources theory might explain some of the emerging findings from the exploratory research. Based on this abductive reasoning, a moderating effect of employee's EI on the relationship between social influence and Industry 4.0 adoption is proposed:

Proposition 2. Employee's emotional intelligence moderates the relationship between

employee's perception of being supported by others (i.e., social influence) and their intention to use Industry 4.0 technologies, ultimately leading to Industry 4.0 technology adoption.

Thirdly, *Transformational Leadership theory* is proposed to enrich our modeling of the enablers of employee's acceptance of Industry 4.0 adoption (Peng et al., in press). In previous studies, charismatic leadership has been considered as an antecedent of all four UTAUT dimensions (Neufeld et al., 2007). A leader's charisma is a component of transformational leadership that utilizes emotions to direct followers (Lord et al., 2017). As noted in the cross-case analysis, the managers in both cases displayed a clear and compelling vision for the future (i.e., inspirational motivation), consideration for employee's views (i.e., individualized consideration), and providing challenge (i.e., intellectual stimulation). These leader behaviors may have contributed to employee's positive expectations about the effects of adopting smart technology in their jobs, including more clarity regarding perceived ease of use and usefulness. Indeed, Schepers et al. (2005) linked transformational leadership to perceived ease of technology use. Other studies have linked transformational leadership to creativity, radical innovation, and employee's innovative work behavior (Bednall et al., 2018; Hughes, Lee, Tian, Newman, & Legood, 2018; Le, 2020). This study sees the UTAUT sub-dimensions as mediating this relationship in the context of employee's acceptance of Industry 4.0 technology adoption. Hence:

Proposition 3. Transformational leadership positively relates to employee's a) expectation that adopting the Industry 4.0 technology will lead to favorable results (i.e., performance expectancy); b) expectation that adopting the Industry 4.0 technology will not cost too much of their effort (i.e., effort expectancy); c) perception of being supported by others (i.e., social influence); and d) perception of having access to enough resources and guidance for adopting those Industry 4.0 technologies (i.e., facilitating conditions), leading, in turn, to employee's Industry 4.0 technology acceptance.

Previous studies have found interactions between transformational leadership and manager's EI (Kim & Kim, 2017). Thus, the fact that Figure 2 incorporates both concepts leads to contemporary future research avenues for the emerging field of Industry 4.0 adoption. Note that, besides these potential additions to the UTAUT model, the original moderator 'voluntariness of use' may still hold, even though their mean scores varied between the two cases. The fact that both cases differed in terms of voluntariness and subjective norm illustrates the complexity of the underlying mechanisms: compliance, internalization, or identification (Venkatesh et al., 2003). A more top-down approach to implementing Industry 4.0 technology may influence social norms and employee's intention to use. The voluntariness dimension may also impact the intention to use new technology when taking a bottom-up approach. Because future studies are warranted on this matter, this moderator is thus kept in the proposed conceptual model (Figure 2).

PRACTICAL IMPLICATIONS

This study underlines the importance of manager's role at various organizational levels in supporting employees to realize their strategic ambitions towards Industry 4.0 (Schneider & Sting, 2020). Before introducing employees to Industry 4.0-type technologies, the two case companies' managers first addressed the socio-emotional side by taking their employees in confidence and involving them in the development process. If people-focus becomes central to Industry 4.0 transformation by their managers, the desired change—or transformation—may be realized quicker.

Another way managers can foster the employee's acceptance to change is to provide them with upskilling or reskilling training to boost their confidence and efficacy in using the Industry 4.0 technology (Srinivasan et al., 2020). Our exploratory findings suggest a training curriculum to include emotional intelligence (Mattingly & Kraiger, 2019) and target both employees and managers. Such organization-wide capability development may help to increase employee's

intention to try and use new technologies.

Thirdly, Human Resource officers responsible for organizational recruitment strategies are advised to incorporate the sub-dimensions of emotional intelligence and transformational leadership in their search and selection profiles. Given that increasingly organizations are adopting a digitization strategy, recruitment should not be only based on people's technical knowledge or skills but also socio-emotional antennas and change skills.

STRENGTHS, LIMITATIONS, AND FUTURE RESEARCH

This is one of the first in-depth field explorations of manager's role in adopting Industry 4.0 technologies in manufacturing firms. The nascent stage of the field led us to use an abductive line of reasoning to answer the research question and employ a mixed-methods research design (Edmondson & McManus, 2007; Ketokivi & Choi, 2014). The rich dataset pointed to various new inquiry lines that will advance our insight into the effective adoption of Industry 4.0 in manufacturing firms, although limitations remain.

Firstly, the study incorporates a few cases in one country with a rather feminine culture (Taras, Steel, & Kirkman, 2012). This may have led the leaders to be more open about their feelings, reducing the finding's generalizability. In addition, the small survey sample size allowed only for very basic quantitative explorations. Thus, testing of hypotheses is advised, through large-scale surveying in multiple countries.

Another restriction concerns the cross-sectional nature of both case studies. People's feelings about major changes are considered emergent states and are likely to fluctuate (Ashkanasy et al., 2017). Similarly, over time, managers may adapt their leadership style and either strengthen their support for the Industry 4.0 initiative or withdraw their support due to a lack of short-term benefits. A longitudinal ethnography is advised to advance our understanding of the evolution of and hurdles in the Industry 4.0 adoption over time.

Because our sample selection was biased towards more effective and advanced cases of Industry 4.0 application, future studies may explore the earlier readiness and piloting stages of Industry 4.0 implementation. This will help in building a guiding coalition supporting the change (Stouten, Rousseau, & De Cremer, 2018), before (top-)managerial decisions are made to invest in them at a larger scale.

Finally, while we initially started the theorizing and operationalizing the variables based on UTAUT and TAM2 modeling, TAM3 emerged from our unfolding literature review. Still, to date, UTAUT or TAM2 are more prevalent in the literature than TAM3 (Williams et al., 2015), also in recent publications on the adoption of Industry 4.0-type technology, such as blockchain (Queiroz, Wamba, De Bourmont, & Telles, in press; Wamba & Queiroz, in press) and production robots and 3D printing (Berlak, Hafner, & Kuppelwieser, in press). In light of the transition towards Industry 4.0, TAM3 incorporates relevant variables such as user's computer playfulness, computer anxiety, and computer self-efficacy (Venkatesh & Bala, 2008). These variables could help uncover the role of individual cognitive frames of Industry 4.0, ranging from anxiety to a more playful and optimistic view (Schneider & Sting, 2020). In addition, we can also explore how emotionally intelligent transformational leaders might detect and act upon such different individual standpoints among their staff.

Given that the Industry 4.0 manufacturing era will drastically change day-to-day operations and supply chains, employees will need to deal with this major change. Some scholars even argued that the current COVID-19 pandemic might have catapulted the importance of investing in Industry 4.0 technology adoption, given its potential contribution to better decision-making and crisis management (Sarkis, 2021). Future studies may, therefore, explore how employee's adoption of *high-tech, intelligent* systems can be supported by their transformational leader's *emotional intelligence*.

REFERENCES

Anderson, N., Potočnik, K., & Zhou, J. 2014. Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. ***Journal of Management***, 40(5): 1297-1333.

Ashkanasy, N. M., Humphrey, S. E., & Huy, Q. N. 2017. Integrating emotions and affect in theories of management. ***Academy of Management Review***, 42(2): 175-189.

Barratt, M., Choi, T. Y., & Li, M. 2011. Qualitative case studies in operations management: Trends, research outcomes, and future research implications. ***Journal of Operations Management***, 29(4): 329-342.

Bednall, T. C., Rafferty, A. E., Shipton, H., Sanders, K., & Jackson, C. J. 2018. Innovative behaviour: How much transformational leadership do you need? ***British Journal of Management***, 29(4): 796-816.

Berlak, J., Hafner, S., & Kuppelwieser, V. G. in press. Digitalization's impacts on productivity: A model-based approach and evaluation in Germany's building construction industry. ***Production, Planning & Control***.

Bott, G. & Tourish, D. 2016. The critical incident technique reappraised: Using critical incidents to illuminate organizational practices and build theory. ***Qualitative Research in Organizations and Management***, 11(4): 276-300.

Cagliano, R., Canterino, F., Longoni, A., & Bartezzaghi, E. 2019. The interplay between smart manufacturing technologies and work organization: The role of technological complexity. ***International Journal of Operations & Production Management***, 39(6/7/8): 913-934.

Calabrese, A., Dora, M., Ghiron, N. L., & Tiburzi, L. in press-a. Industry's 4.0 transformation process: How to start, where to aim, what to be aware of. ***Production, Planning & Control***.

Calabrese, A., Levialdi Ghiron, N., & Tiburzi, L. in press-b. 'Evolutions' and 'revolutions' in manufacturers' implementation of industry 4.0: A literature review, a multiple case study, and a conceptual framework. ***Production, Planning & Control***.

Chiarini, A. & Kumar, M. in press. Lean six sigma and industry 4.0 integration for operational excellence: Evidence from Italian manufacturing companies. ***Production, Planning & Control***.

Cimini, C., Boffelli, A., Lagorio, A., Kalchschmidt, M., & Pinto, R. in press. How do industry 4.0 technologies influence organisational change? An empirical analysis of Italian SMEs. ***Journal of Manufacturing Technology Management***.

Cropanzano, R., Anthony, E. L., Daniels, S. R., & Hall, A. V. 2017. Social exchange theory: A critical review with theoretical remedies. ***Academy of Management Annals***, 11(1): 1-38.

Da Silva, V. L., Kovaleski, J. L., Pagani, R. N., Silva, J. D. M., & Corsi, A. 2020. Implementation of Industry 4.0 concept in companies: Empirical evidences. ***International Journal of Computer Integrated Manufacturing***, 33(4): 325-342.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. 1989. User acceptance of computer technology: A comparison of two theoretical models. ***Management Science***, 35(8): 982-1003.

Dooley, D. 2009. ***Social research methods*** (Fourth ed.). Upper Sadle River, New Jersey: Prentice-Hall, Inc.

Edmondson, A. C. & McManus, S. E. 2007. Methodological fit in management field research. ***Academy of Management Review***, 32(4): 1155-1179.

Fetters, M. D., Curry, L. A., & Creswell, J. W. 2013. Achieving integration in mixed methods designs: Principles and practices. ***Health Services Research***, 48(6): 2134-2156.

Fishbein, M. & Ajzen, I. 1975. ***Belief, attitude, intention and behavior: An introduction to theory and research***. Reading, MA: Addison-Wesley.

Flanagan, J. C. 1954. The critical incident technique. ***Psychological Bulletin***, 51(4): 327-358.

Frank, A. G., Dalenogare, L. S., & Ayala, N. F. 2019. Industry 4.0 technologies: Implementation patterns in manufacturing. ***International Journal of Production Economics***, 210(April): 15-26.

Gibney, R., Zagenczyk, T. J., & Masters, M. F. 2009. The negative aspects of social exchange: An introduction to perceived organizational obstruction. ***Group & Organization Management***, 34(6): 665-697.

Grodal, S., Anteby, M., & Holm, A. L. in press. Achieving rigor in qualitative analysis: The role of active categorization in theory building. ***Academy of Management Review***.

Hahn, G. J. 2020. Industry 4.0: A supply chain innovation perspective. ***International Journal of Production Research***, 58(5): 1425-1441.

Harlan, J. 2020. ***Change, employee resistance to change, and emotional intelligence: A meta-analysis***. Unpublished doctoral dissertation, Northcentral University.

Hughes, D. J., Lee, A., Tian, A. W., Newman, A., & Legood, A. 2018. Leadership, creativity, and innovation: A critical review and practical recommendations. ***The Leadership Quarterly***, 29(5): 549-569.

Huy, Q. N. 1999. Emotional capability, emotional intelligence, and radical change. ***Academy of Management Review***, 24(2): 325-345.

Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. 2007. Toward a definition of mixed methods research. ***Journal of Mixed Methods Research***, 1(2): 112-133.

Joseph, D. L. & Newman, D. A. 2010. Emotional intelligence: An integrative meta-analysis and cascading model. ***Journal of Applied Psychology***, 95(1): 54-78.

Ketokivi, M. & Choi, T. 2014. Renaissance of case research as a scientific method. ***Journal of Operations Management***, 32(5): 232-240.

Kim, H. & Kim, T. 2017. Emotional intelligence and transformational leadership: A review of empirical studies. ***Human Resource Development Review***, 16(4): 377-393.

Le, P. B. 2020. How transformational leadership facilitates radical and incremental innovation: The mediating role of individual psychological capital. ***Asia-Pacific Journal of Business Administration***, 12(3/4): 205-222.

Lee, J. Y., Rocco, T. S., & Shuck, B. 2020. What is a resource: Toward a taxonomy of resources for employee engagement. ***Human Resource Development Review***, 19(1): 5-38.

Liao, Y., Deschamps, F., Loures, E. D. F. R., & Ramos, L. F. P. 2017. Past, present and future of Industry 4.0: A systematic literature review and research agenda proposal. ***International Journal of Production Research***, 55(12): 3609-3629.

Liboni, L. B., Cezarino, L. O., Jabbour, C. J. C., Oliveira, B. G., & Stefanelli, N. O. 2018. Smart industry and the pathways to HRM 4.0: Implication for SCM. ***Supply Chain Management: An International Journal***, 24(1): 124-146.

Lord, R. G., Day, D. V., Zaccaro, S. J., Avolio, B. J., & Eagly, A. H. 2017. Leadership in applied psychology: Three waves of theory and research. ***Journal of Applied Psychology***, 102(3): 434-451.

Lukes, M. & Stephan, U. 2017. Measuring employee innovation: A review of existing scales and the development of the innovative behavior and innovation support inventories across cultures. ***International Journal of Entrepreneurial Behavior & Research***, 23(1): 136-158.

Magni, M. & Pennarola, F. 2008. Intra-organizational relationships and technology acceptance.

International Journal of Information Management, 28(6): 517-523.
Mattingly, V. & Kraiger, K. 2019. Can emotional intelligence be trained? A meta-analytical investigation. ***Human Resource Management Review***, 29(2): 140-155.
Neufeld, D. J., Dong, L., & Higgins, C. 2007. Charismatic leadership and user acceptance of information technology. ***European Journal of Information Systems***, 16(4): 494-510.
Olsen, T. L. & Tomlin, B. 2020. Industry 4.0: Opportunities and challenges for operations management. ***Manufacturing & Service Operations Management***, 22(1): 113-122.
Oreg, S., Bartunek, J. M., Lee, G., & Do, B. 2018. An affect-based model of recipients' responses to organizational change events. ***Academy of Management Review***, 43(1): 65-86.
Peng, J., Li, M., Wang, Z., & Lin, Y. in press. Transformational leadership and employees' reactions to organizational change: Evidence from a meta-analysis. ***The Journal of Applied Behavioral Science***.
Queiroz, M. M., Wamba, S. F., De Bourmont, M., & Telles, R. in press. Blockchain adoption in operations and supply chain management: Empirical evidence from an emerging economy. ***International Journal of Production Research***.
Rego, A., Sousa, G., Cunha, M. P., Correia, A., & Sair-Amaral, I. 2007. Leader self-reported emotional intelligence and perceived employee creativity: An exploratory study. ***Creativity and Innovation Management***, 16(3): 250-264.
Rezvani, A., Chang, A., Wiewiora, A., Ashkanasy, N. M., Jordan, P. J., & Zolin, R. 2016. Manager emotional intelligence and project success: The mediating role of job satisfaction and trust. ***International Journal of Project Management***, 34(7): 1112-1122.
Sarkis, J. 2021. Supply chain sustainability: Learning from the COVID-19 pandemic. ***International Journal of Operations & Production Management***, 41(1): 63-73.
Schaufeli, W. B. & Taris, T. W. 2014. A critical review of the job demands-resources model: Implications for improving work and health. In G. F. Bauer & O. Hämmig (Eds.), ***Bridging occupational, organizational and public health: A transdisciplinary approach***: 43-68. Dordrecht, the Netherlands: Springer Science+Business Media.
Schepers, J., Wetzels, M., & De Ruyter, K. 2005. Leadership styles in technology acceptance: Do followers practice what leaders preach? ***Managing Service Quality***, 15(6): 496-508.
Schneider, P. & Sting, F. J. 2020. Employees' perspectives on digitalization-induced change: Exploring frames of industry 4.0. ***Academy of Management Discoveries***, 6(3): 406-435.
Schroeder, R. G., Linderman, K., & Zhang, D. 2005. Evolution of quality: First fifty issues of Production and Operations Management. ***Production and Operations Management***, 14(4): 468-481.
Scott, S. G. & Bruce, R. A. 1994. Determinants of innovative behavior: A path model of individual innovation in the workplace. ***Academy of Management Journal***, 37(3): 580-607.
Srinivasan, R., Kumar, M., & Narayanan, S. 2020. Human resource management in an industry 4.0 era: A supply chain management perspective In T. Y. Choi, J. J. Li, D. S. Rogers, T. Schoenherr, & S. M. Wagner (Eds.), ***The Oxford handbook of supply chain management*** Oxford: Oxford University Press.
Stouten, J., Rousseau, D. M., & De Cremer, D. 2018. Successful organizational change: Integrating the management practice and scholarly literatures. ***Academy of Management Annals***, 12(2): 752-788.
Strauss, A. & Corbin, J. 2002. ***Basics of qualitative research: Techniques and procedures for developing grounded theory*** (3rd ed.). Thousand Oaks, CA: Sage Publications.
Taras, V., Steel, P., & Kirkman, B. L. 2012. Improving national cultural indices using a

longitudinal meta-analysis of Hofstede's dimensions. ***Journal of World Business***, 47(3): 329-341.

Thoben, K. D., Wiesner, S., & Wuest, T. 2017. "Industrie 4.0" and smart manufacturing: A review of research issues and application examples. ***International Journal of Automation Technology***, 11(1): 4-16.

Tortorella, G. L., Giglio, R., & Van Dun, D. H. 2019. Industry 4.0 adoption as a moderator of the impact of lean production practices on operational performance improvement. ***International Journal of Operations & Production Management***, 39(6/7/8): 860-886.

Venkatesh, V. 2000. Determinants of perceived ease of use: Integrating perceived behavioral control, computer anxiety and enjoyment into the technology acceptance model. ***Information Systems Research***, 11(4): 342-365.

Venkatesh, V. & Davis, F. D. 2000. A theoretical extension of the technology acceptance model: Four longitudinal field studies. ***Management Science***, 46(2): 186-204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. 2003. User acceptance of information technology: Toward a unified view. ***MIS Quarterly***, 27(3): 425-478.

Venkatesh, V. & Bala, H. 2008. Technology acceptance model 3 and a research agenda on interventions. ***Decision Sciences***, 39(2): 273-315.

Vidyarthy, P. R., Anand, S., & Liden, R. C. 2014. Do emotionally perceptive leaders motivate higher employee performance? The moderating role of task interdependence and power distance. ***The Leadership Quarterly***, 25(2): 232-244.

Voss, C., Tsikriktsis, N., & Frohlich, M. 2002. Case research in operations management. ***International Journal of Operations & Production Management***, 22(2): 195-219.

Wagire, A. A., Joshi, R., Rathore, A. P. S., & Jain, R. in press. Development of maturity model for assessing the implementation of Industry 4.0: Learning from theory and practice. ***Production, Planning & Control***.

Wamba, S. F. & Queiroz, M. M. in press. Industry 4.0 and the supply chain digitalisation: A blockchain diffusion perspective. ***Production, Planning & Control***.

Wiens, K. & Rowell, D. 2018. How to embrace change using emotional intelligence. ***Harvard Business Review***.

Williams, M. D., Rana, N. P., & Dwivedi, Y. K. 2015. The unified theory of acceptance and use of technology (UTAUT): A literature review. ***Journal of Enterprise Information Management***, 28(3): 443-488.

Wong, C. S. & Law, K. S. 2002. The effects of leader and follower emotional intelligence on performance and attitude: An exploratory study. ***The Leadership Quarterly***, 13(3): 243-274.

Yammarino, F. J. 2013. Leadership: Past, present, and future. ***Journal of Leadership & Organizational Studies***, 20(2): 149-155.

Yin, R. K. 2011. ***Qualitative research from start to finish***. New York, NY: The Guilford Press.

Zeidner, M., Matthews, G., & Roberts, R. D. 2004. Emotional intelligence in the workplace: A critical review. ***Applied Psychology: An International Review***, 53(3): 371-399.

Zhou, J. & George, J. M. 2003. Awakening employee creativity: The role of leader emotional intelligence. ***The Leadership Quarterly***, 14(4): 545-568.

APPENDIX A

Semi-structured Interview Guide

The interview starts with getting a refreshment, along with an informal chat during which the interviewer and interviewee agree on the current radical, Industry 4.0-type technological change within the company, on which the interview will focus. Furthermore, permission is requested for the audio recording during the interview and the consent form is signed, with which the respondent agrees with the data collection and participation in the study.

General Introduction

1. Could you please introduce yourself and your position within the company? (age, job position, job and organizational tenure, educational level)
2. How would you describe the company, the type of products it delivers and the organizational culture?

General Organizational Changes

3. Which (technological) changes were implemented in the organization in the past couple of years?
4. How do you typically respond to change within your organization? Why?

Organizational Changes Regarding Industry 4.0

5. What change has the company experienced regarding Industry 4.0 adoption?
6. Why were those radical technological changes implemented?
7. How were those changes communicated within the organization?

8. How did this change affect your job or you personally?
9. How did the managers communicate about these changes?
10. How did this way of communicating affect your own personal feelings regarding the Industry 4.0 adoption?
11. To what extent do you support the Industry 4.0 change project within your organization? Can you give an example of how you support the project?
12. How did the change itself affect your emotions?
13. To what extent did your supervisors and colleagues recognize and acknowledge your emotions?
14. How did your supervisors and colleagues act upon these emotions?
15. How did their response affect you?

Conclusion

16. Is there anything else you would like to discuss regarding the Industry 4.0 adoption which we have not yet discussed?

Thank you for your time and effort. The audio file will be transcribed, while anonymizing the data. In case the interviewee would like to add any points, this is possible.

FIGURE 1

Visualization of the Qualitative Data Open, Axial and Selective Codes

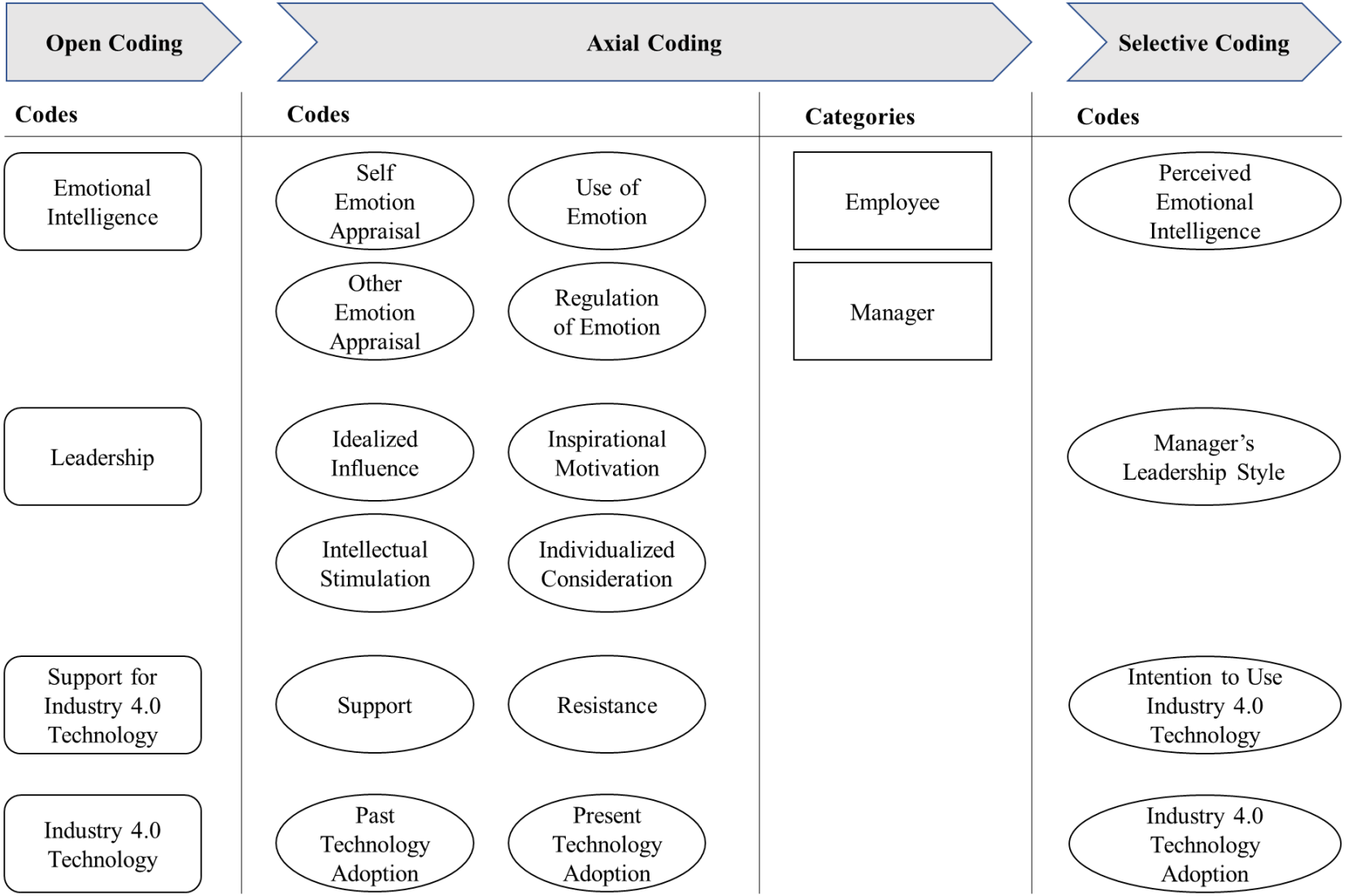

FIGURE 2

Conceptual Model of the Enablers of Industry 4.0 Technology Adoption

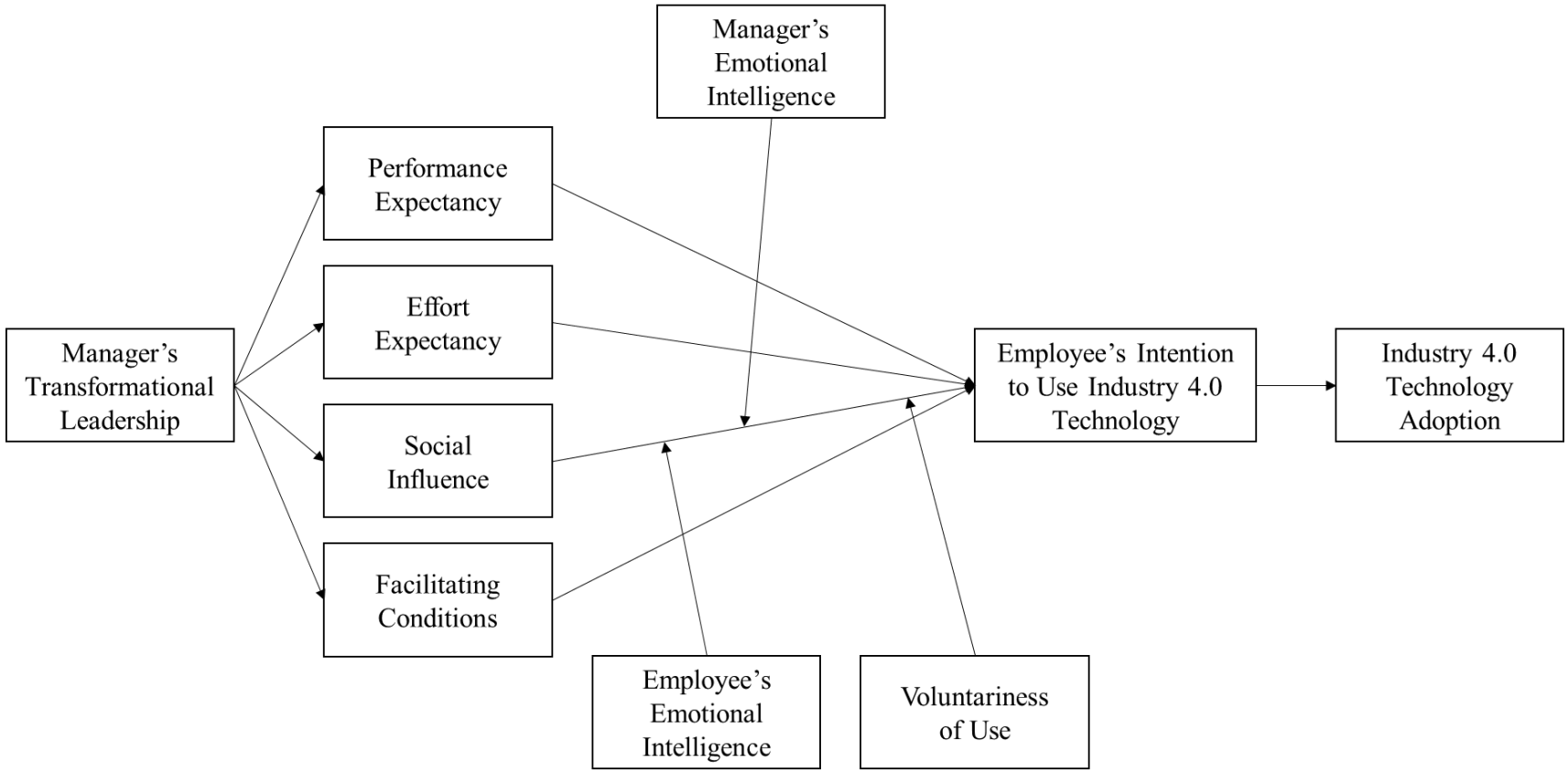

TABLE 1

Case Company Characteristics

Company	**Fabricator Case**	**HoloLens Case**
Industry	Metalworking machinery	Design and engineering
Size	~700 employees	~250 employees
Company age	>45 years	>45 years
Company location	The Netherlands	The Netherlands
Level of automation	Medium labor intensive	Medium labor intensive
Type of Industry 4.0 technology adopted	Cyber-physical Systems	Augmented reality
Interview participants	3 employees; 2 managers	5 employees; 4 managers
Survey participants	8 employees; 2 managers	3 employees; 7 managers

TABLE 2

Survey-based Descriptive Statistics for Each Case

		Fabricator Case	HoloLens Case
Variable (no. of final items)	**α**	**M**	**M**
Manager's EI (14)	.648[a]	5.71	5.52
Employee's EI (15)	.691[b]	5.40	5.27
Perceived usefulness (4)	.969	4.84	6.33
Perceived ease of use (4)	.823	5.84	4.92
Subjective norm (2)	.879	5.00	4.33
Perceived support for innovation (8)	.923	3.56	5.79
Intention to use (2)	.960	5.69	6.17
Industry 4.0 adoption (4)	.851[c]	6.00	5.50
Voluntariness (2)	.755[d]	3.44	6.00

Note. All scales were measured on a seven-point scale, where 1 represents a low score and 7 represents a high one.

[a] Two items were removed: "I am quite capable of controlling my own emotions" and "I can always calm down quickly when I am very angry".

[b] One item was removed: "I always know whether or not I am happy".

[c] One item was removed: "Digital automation without sensors".

[d] One item was removed: "Although it might be helpful, using the Industry 4.0 technology is certainly not compulsory in my job".