x=(tourism_work) y=(sdg8) while y=true: automate(x)

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Highlights

- Automation is adopted as a strategy to address labor shortage issues in tourism
- While displacing some tourism employment, automation also creates new tasks and roles
- Automation can promote decent work in tourism by effective human-machine cooperation
- Automation may improve and increase working conditions, rewards, and empowerment
- Preparing for a more automated future requires investment in skills development

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Abstract

Increasing implementation of automation has brought global concerns over the future of jobs in various sectors. To ensure that the transition to automation in travel and tourism will be made in a responsible and accountable manner, this study conceptualizes how automation, found to be driven largely by labor shortage, can be used to promote decent work. Utilizing Grounded Theory to analyze data from in-depth interviews and focus group discussions with industry practitioners, this study provides rich descriptions of the transformation brought by automation to companies, employees, and wider society and develops a theoretical model to explain 'Decent Work through Automation' (DW–A). In doing so, this study opens a pathway for further research on technology and decent work in tourism, including second- and third-order impacts of emerging technology. The paper offers practitioners and policymakers guidelines for responsible adoption of automation.

Keywords: automation; artificial intelligence; robotics; decent work; employment; sustainable development goals

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Introduction

Today's society is marked by the fourth industrial revolution, or 'Industry 4.0' (Schwab, 2017). This term is used to describe a set of transformations, both ongoing and impending, brought by rapidly emerging technologies referred to as cyber-physical systems. Technological advances in artificial intelligence (AI) and robotics are projected to profoundly impact many aspects of life (ICAR, 2018), introduce new ways of creating value, and disrupt current industries and organizational models (WEF, 2018). The anticipated scale and scope of automation our society will experience due to the use of AI and robots brings an added layer of anxiety to the global concern for jobs (Manyika et al., 2017; UNA-UK, 2018). AI, automation and robotics have the potential to create employment for a lot of people and thus be a significant driver of economic growth (Ernst, Merola, & Samaan, 2018). However, there is a legitimate concern that the use of robots will displace demand for human labor, especially low-skilled workers and those performing routinized tasks, in a broad range of sectors and industries (Das & Hilgenstock, 2018; Frey & Osborne, 2017). The labor-intensive travel and tourism sector is no exception.

The WEF (2018) has projected that in the next five year 75 million jobs will be replaced due to automation, while an additional 133 million new jobs will be created. As a result, a new approach to support job transitions, including reskilling and retraining effort, will be necessary. Even for occupations that will not be replaced entirely by machines, reskilling and upskilling of employees will be required due to the significant change automation will bring to work (Dobrusin, 2019). As an increasing number of tasks within tourism and hospitality services will fall victim to impending automation, companies are faced with deciding to either lay off people

as their roles become redundant, or restructure and reinvent existing roles, letting robots take over boring and demeaning jobs, giving more meaningful tasks to humans. Importantly, a new breed of fully automated hospitality services (e.g., robotized hotels) has been introduced as novel offerings in the sector. Following in the footsteps of airline companies to apply self-service technologies, they rely on radical efficiency from needing less human labor.

In order to guarantee that adoption of advanced technologies will promote sustained, inclusive, and sustainable growth, the transition to automation needs to be made in a responsible and accountable manner (ICAR, 2018). Policymakers are called to prioritize investments in decent and sustainable work, to put in place plans for job creation, to support transitioning workers, and to provide wider social protections (Benson Wahlén, 2019; UNA-UK, 2018). Equally important is the role companies play in helping workers adapt and prepare for new opportunities brought by AI and robotics. Ultimately, using technological innovation to accelerate the attainment of Sustainable Development Goals (SDGs), particularly SDG 8, which promotes full and productive employment and decent work for all, requires policymakers and companies to work synergistically (ICAR, 2018). The limited empirical research in this area means despite the increasing automation in travel and tourism it is largely unknown if the underlying people management strategies that come with the adoption of automation are in line with supporting human development and providing safe, stable, and well-paid jobs.

This study aims to better understand whether and how companies use automation to support the provision of decent work in travel and tourism. To that end, the study addresses the following research questions: How and why are travel and tourism companies currently implementing automation? How do these strategies reflect the SDGs and how can automation be leveraged to provide decent work in tourism? We gathered information by way of in-depth

interviews with managers of fully automated hotels and restaurants and focus group discussions with a group of tourism and hospitality practitioners whose organizations have adopted varying levels of automation. Themes emerging from the narratives were analyzed to gain a better understanding of the current practice of automation and provision of decent work in the travel and tourism sector. The results contribute to guiding the direction for responsible and accountable adoption of automation in travel and tourism.

Tourism, Automation, and Decent Work

Over the last few decades, the tourism sector has become one of the most important drivers of global economic growth and development, as well as a major contributor to global employment (Statista, 2018). The World Travel & Tourism Council (WTTC, 2019) estimated that in 2018 the sector accounted for around 319 million jobs (10% of total employment) globally. The trend is likely to continue, with more people indulging in tourism-related activities due to more accessible and affordable destinations and means of travel, new business models, as well as changes in technology. In early 2019, the United Nations World Tourism Organization (UNWTO, 2019) had to update its future projections regarding global tourist arrivals as previous targets were met two years ahead of forecasts.

To cope with ever-increasing demand, tourism businesses are turning towards AI and robotics to automate repetitive manual and information-processing tasks (Ivanov & Webster, 2019a; 2019b; Wirtz et al., 2018). For example, early stage and newly founded companies such as Creator, Winnow, and Dishcraft are leveraging service robotics and computer vision to automate back-of-house tasks such as cooking, waste-sorting, and dishwashing in restaurants (Bird, 2018; Albrecht, 2019; Chapman, 2019). Industry giant McDonald's is using learning

algorithms to optimize its digital menus based on attributes such as weather, local events, and competitors' promotional campaigns (Keyes, 2019). Singapore's Changi Airport is automating much of its logistics and people processing tasks, such as luggage handling and security screening (Park, 2018). Finally, Henn-na Hotel, a mid-market hotel chain currently undergoing a rapid scale-up, has attempted to automate most of its check-in, luggage storage, room service, upkeep, and concierge tasks (Liao, 2019).

Automating tasks offers tourism businesses an effective means to increase operational efficiency, cut costs, differentiate, and serve customers in novel ways (Kuo, Chen, & Tseng, 2017; Ivanov and Webster, 2019b; Murphy, Gretzel, & Pesonen, 2019). Automation technologies also offer novel avenues of research, especially with regards to managing transformed operations and new offerings in tourism (Murphy, Hofacker, & Gretzel, 2016; Tung & Law, 2017). However, the increased automation of tasks, processes, and, ultimately, jobs stands to change the way we think of work in the sector (Ivanov & Webster, 2019b). More research into the potentially disruptive societal issues resulting from increased automation, such as unemployment, displacement, and the need to reskill and upskill employees at scale, is needed (Future of Life Institute, 2017).

The United Nations Sustainable Development Goals (SDGs) offer a globally agreed macro level framework for assessing current organizational practices as well as strategically planning for future action towards greater economic, environmental, and social sustainability (Hall, 2019). Aiming to elicit change through more actionable goals (Boluk, Cavaliere, & Higgins-Desbiolles, 2019), the United Nations laid out 17 development targets in 2015. Particularly relevant to tourism employment is SDG 8, which calls for sustainable economic

growth, higher levels of productivity, and technological innovation through the provision of full and productive employment and decent work for all (UN, 2018).

According to Ghai (2003) the concept of decent work stands on four key pillars: employment, social protection, workers' rights, and social dialogue. It encompasses issues as wide ranging as gender equality, remuneration, health and safety, social and income security, freedom of association and the right to express views, non-discrimination at work, and the absence of forced or child labor, among others (Baum et al., 2016). An important consideration to decent work is the degree to which countries at different stages of development and with different ingrained assumptions of work itself envision and action the concept of decent work. For example, Ribeiro, Teixeira and Ambiel (2019) explored what decent work meant to workers in Brazil, and found that the provision of fair income, a safe and stable working environment, as well as the social protection for workers' families and a good healthcare plan dominated the discussion. In contrast, Dodd, Hooley and Burke (2019) found that in the United Kingdom employees tended to emphasize the importance of work-life balance, career progression, personal development, and the feeling that their work contributed positively towards something bigger.

Given the global push towards more sustainable employment practices, and the tourism sector's significant contribution to local and global economies, several authors have explored the concept of decent work in the context of tourism (Bramwell et al., 2017; Winchenbach, Hanna, & Miller, 2019) and recognized the many examples of poor employment practices (Robinson et al., 2019). This is due to several colliding factors: low entry barriers, comparatively high turnover, low wages, high stress and mentally and physically demanding tasks, among others. The common practice of exporting and exploiting migrant labor, as well as the seasonality of the

sector, only exacerbate these factors. Although progress towards the sustainability of the sector has been made across several fronts (Budeanu et al., 2016), Robinson et al. (2019) see that tourism literature and policy often neglect the social dimension of sustainability, particularly with regards to employment. McCloskey (2015) attributes this to the dominant neoliberal economic model which largely prioritizes growth (e.g., in terms of GDP) over wider measures of "decency".

The International Labour Organization (ILO, 2019) sees technology as a potential means to achieve sustained economic growth combined with productive and decent work and fair globalization. Hall (2019) concurs, emphasizing the role of tourism companies in managing and using technology to address environmental, economic, and social problems. Huang & Rust, 2018) acknowledge the potentially positive effects of emerging technology through moves towards more fulfilling and meaningful jobs that involve problem solving, creative thinking, and emotional intelligence as opposed to systematic processing of goods, people, or data) Frey & Osborne (2017) warn against the disruptive impacts of automation on employment both at the national and global level. Even though some types of routinized work (e.g., ground transport, conducting routine legal due diligence) may disappear completely, it is far more likely that AI and robotics change the type and number of tasks performed in most occupations (ILO, 2018). Kucera (2017) argues that this is because jobs typically include both readily automatable and not readily automatable tasks. For example, a chef's job includes the preparation and cooking of ingredients (readily automatable) as well as flavor profiling and plating (not readily automatable). The strategies businesses adopt to manage the transition to automation will ultimately determine how decent work will manifest in the future.

It is important to acknowledge that this is not the first time technology has been poised to impact work: history has already seen several technological revolutions that have had implications for global employment (Tegmark, 2017). The industrial revolution gave birth to mass production, boosting the manufacturing sector significantly. This later launched the world into a more service-dominant economy, whereby people moved from the production of goods to the provision of services. The digital revolution gave us the internet, radically disrupting the service landscape by opening up completely new business models and employment opportunities. The information revolution offered novel tools to leverage the aggregation of big data, again leading to new types of businesses and career paths (Harari, 2015). Atkinson and Wu (2017) analyzed the impacts of technology on employment in the US between 1850 and 2015 and found that technology has not led to significant increases in unemployment. On the contrary, technological progress has resulted in more jobs, and new types of jobs, albeit many existing skills become redundant and new skills need to be acquired to capitalize on the new opportunities. Seen historically, the emergence of intelligent automation is a continuation of previous technological revolutions. However, several leading thinkers have warned that this time the impacts on employment may be more severe due to the sheer scale and speed of technological progress (Brynjolfsson & McAfee, 2014; Russell, Dewey, & Tegmark, 2015). Research places accommodation, transport, and food service as particularly vulnerable to automation (PwC, 2018). If technological progress continues as predicted, more and more tasks will be automated, and, consequently, existing work will need to be restructured and impacted employees retrained. However, the tourism industry has traditionally been slow to react to technological changes. As such, it is likely that current people management practices might not adequately reflect the eventual transformation. More research into the nature of automation and

so the impacts of automation on the provision of decent work in tourism is thus needed to ensure a socially sustainable future.

Methodology

Considering that automating tourism jobs is a relatively new phenomenon with potential profound impact to the sector, useful theoretical conceptualizations around the transformation brought by automation in the sector are essential. To address this need, this research applied Grounded Theory, a qualitative research methodology developed in the field of sociology aiming at generating empirically grounded theory based on systematic exploration of a phenomenon (Glaser, 1978; Strauss, 1987; Strauss & Corbin, 1990). Key to Grounded Theory is the discovery of theoretical conceptualization based on a rigorous, systematic, and comprehensive approach to data collection and analysis (Fernandez & Lehmann, 2005; Urquhart & Fernandez, 2016). Grounded Theory can be characterized by joint collection and analysis of data, construction of categories as they emerge from data instead of deduced hypotheses, constant comparison, and theoretical sampling (i.e., sampling aimed toward theory construction, not to be representative of the population) (Charmaz, 2006). The outcomes of Grounded Theory can lead to three different contributions: theory (i.e., statements of descriptions, definitions of variables, their relationships, justification for those relationships, and the boundaries of the theory), model (i.e., definitions of abstract variables and relationships), or rich description (i.e., narratives of empirical observations without abstraction) (Wiesche et al., 2017).

Data for this study were collected by way of semi-structured interviews and focus group discussions conducted in the span of eight months from September 2018 to June 2019. Studying a new phenomenon, it is important to target experts wherein lie relevant interpretive knowledge

('know-why') and procedural knowledge ('know-how') (Bogner & Menz, 2009) regarding the transformation in tourism work due to automation. Founders and managers, as the agents designing and/or overseeing the implementation of automation in tourism services, are considered experts. Interviews were conducted with 12 founders or general managers of (fully) automated hotels and restaurants: one from Hungary, four from Japan, four from the UK, and three from the US. They were selected to represent the only brands/companies operating in robotized/automated services during the time of the study. Most interviewees were involved in the founding of the company; two managers were hired later as the brand expanded its operation into different locations. As interviewees were selected for their expertise, their personal information was considered irrelevant and so not collected.

The interview questions included the following: (a) what prompted the company to adopt automation, (b) how processes and operations have been transformed, (c) how the roles of employees have changed, and (d) what company's visions are for the future (see Supplement for details). All interviews were scheduled for one hour; the longest took 98 minutes. In hotels, the interviewers were given a tour of the property before or after the interviews (lasting between 30 – 60 minutes), and in some cases were asked to stay overnight to fully experience the automated service. This allowed the interviews to go deeper into specific areas, such as the types of automation in front-of-house and back-of-house operations, and the design of different jobs/roles. Four interviews with hotel managers in Japan were conducted on site by two authors, rotating between three who have basic to advanced knowledge of the Japanese language. The interviews were audio recorded, professionally transcribed, and then professionally translated into English. Other interviews were conducted in English either face-to-face or via Skype. These were audio recorded and automatically transcribed.

In addition, two intensive focus group discussions were conducted with tourism and hospitality practitioners in the UK whose organizations adopt varying levels of automation (eight and 17 participants, respectively). The aim of combining interviews with focus groups was mainly to find convergence of the salient points captured through the individual accounts of the interviewees and those emerged through interactions in the focus groups, thus enhancing trustworthiness of the findings (Lambert & Loiselle, 2008). The focus groups lasted a full day each, and brought together representatives (i.e., founders, chief technology/information officers, general managers, developers, analysts) from a global fast food chain, a fine dining restaurant group, a casual dining restaurant group, a hotel group, local tourism operators and entrepreneurs, travel technology startup companies, and a global travel trade organization. Three authors facilitated and took turn to moderate the discussions throughout the day. In addition to the questions covered in the interviews, the focus group facilitated reflection on technological trends in relation to tourism jobs and visioning the future of tourism and hospitality services. The discussions were conducted in English; they were audio recorded and professionally transcribed.

The transcripts were analyzed as soon as they become available according to the following coding procedure (Glaser, 1978; Strauss, 1987; Strauss & Corbin, 1990; Wiesche et al., 2017): open coding (i.e., initial labelling of all data), axial coding (i.e., a deeper analysis of all categories), selective coding (i.e., identifying select categories that are related a core category), and theoretical coding (i.e., identifying relationships between categories that are associated with a core category). Three authors independently labelled the data (open coding) and went through several rounds of discussion to merge or collapse initial labels into core categories (axial coding). The authors then performed selective coding (identifying only instances that are related to the core categories) independently and came together to produce a

final code tree, listing all core categories with examples. Due to simultaneous data collection and analysis, authors often performed selective coding on previously labelled data while open coding new batches of data. Two authors (who were not involved in open coding) independently coded a selection of quotes using the code tree in order to verify the results, ensuring the trustworthiness of the analytical codes and categories. Disagreements were resolved through discussion. Finally, theoretical coding was performed through several discussions involving all authors, facilitated by a digital project management platform. The main codes representing impacts of automation are: [A] displacement of workers, [B] job design: human–robot cooperation, [C] new jobs, [D] smart materials and workplaces, and [E] further impacts, which consists of three lower level codes: [E1] impacts on employees, [E2] impacts on companies, and [E3] broader impacts (see Supplement for details). Throughout the coding and analysis process, constant comparison amongst units of data (amongst categories, between categories and concepts) was followed to ensure the study findings are grounded in rigorous systematic procedures (Glaser & Strauss, 1967). Literature review was performed after independent analysis was completed.

Results and Discussion

The main factor driving the adoption of automation by tourism and hospitality companies revealed through interviews and focus groups is labor shortage. The initial focus uncovered is of automation as a way to reduce reliance on human labor by replacing workers. However, as companies faced challenges during the implementation of automation (e.g., arising from technological limitations), it becomes apparent that companies prefer human-robot cooperation where processes and tasks are distributed between machines and human labor. Several categories

of outcomes of automation in tourism and hospitality operations were identified and their relationships conceptualized (see Figure 1).

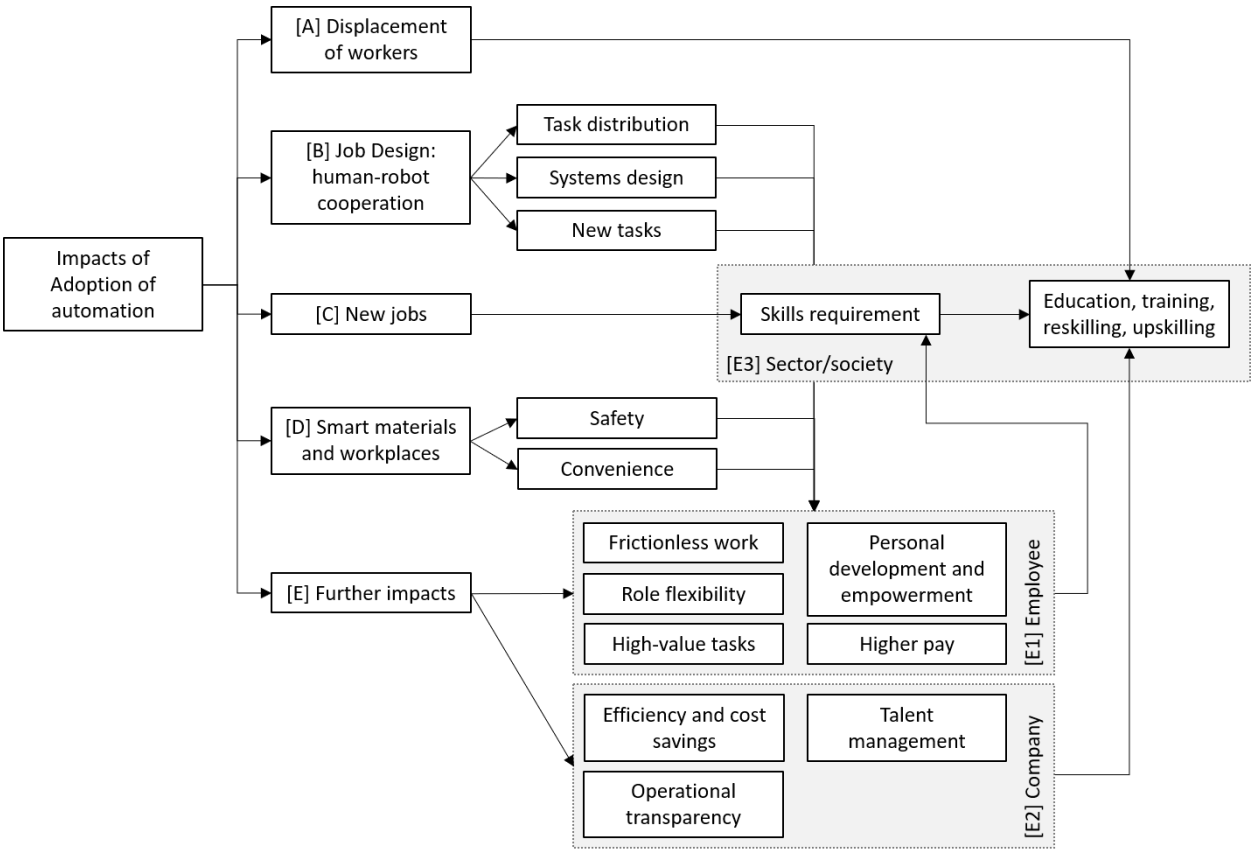

Figure 1. Automation and Transformation in Work, Workplaces, and Workforce

Displacement of workers

Consistent with the goal of substituting human labor (i.e., providing services with minimal labor), the need for employees is significantly reduced as intelligent systems are deployed to take over tasks typically performed by humans. A hotel manager stated that: *"in 20 years, the* [Brand] *Hotel will probably be on the path to reduce human labor.* […] *Even more. It's our goal after all*." To run a robotized hotel, as stated by another manager, requires only "*one third of the headcount…*", when compared to conventional hotels. This confirms what has been suggested about prospects of

job losses in the services sector due to increasingly automatable service processes (Arntz, Gregory, & Ziehran, 2016; Flynn & Wilson, 2019; Frey & Osborne, 2017). To companies, automation initially is seen to translate directly to a significant reduction in labor cost.

Job design: human-robot cooperation

Perhaps the most extensively discussed topic was distribution of tasks in the workplace as companies define automatable processes for optimum human–machine cooperation. Relatively distinct tasks in the service processes were explored by the managers: procedural and transactional tasks (e.g., cleaning, reservation, payment) and relational tasks (e.g., giving recommendations, interacting with guests). In general, managers were in agreement regarding delegating procedural and transactional tasks to robots or automated systems (e.g., automatically generating invoices), allowing employees to perform higher value relational tasks (e.g., talking to the guests). A restaurant manager suggested that "[automation] *seems to have a much more positive* [impact] *on interaction where it wasn't necessarily about the product. It was much more about human interaction and social interaction rather than transaction interaction."* However, while some companies' initial approach was to implement this clear division of labor, they later found that at times humans are still needed to ensure the tasks performed automatically would be completed to perfection. As suggested by Flynn and Wilson (2019), the first round of impact of automation is the replacement of tasks, which can vary from none to all tasks being replaced. This study shows that even in routine manual tasks initially considered entirely automatable (e.g., cleaning), there is an inherent complexity that prevents them from being completely delegated to current technologies. In other words, automation replaced most, but not all tasks.

Consequently, in most cases there is a certain degree of flexibility in task distribution between robots and employees.

While flexibility in task distribution was considered a positive approach to automation-dominated job design, some managers admitted that this was due to some constraints in systems design (e.g., types of robots, functionalities) and technical limitations of robots (e.g., proneness to errors or malfunctions, performance levels). For example, a hotel manager lamented that robot cleaner only achieved 70% of the expected performance level to properly clean a hotel room; an employee was needed to perform a final spot check to ensure guests would be satisfied with room cleanliness. He stated: "*At first I had high expectations for the cleaning robots that it would do everything perfectly, but then I realized there was trash left behind. I thought about it and changed my way of thinking, that letting the robots do half the work humans used to have to do will help cut down a bit the time humans spent cleaning."* In consequence, managers further stated that they prefer implementing simple rather than complex robots (having single vs. multiple functionalities) as the latter are proven to be prone to breakage and complications, and are not easy to maintain, a task they wish to eliminate from their employees' responsibility.

Furthermore, sometimes getting rid of one procedural task simply leads to another. For example, some restaurant managers lamented that even though automating certain kitchen processes had brought savings on several fronts (e.g., increases in efficiency affording parts of back-of-house space to be repurposed for guest use), new processes had emerged. Due to technical restrictions, the kitchen machines could only handle ingredients that were of similar shapes and sizes. Employees had to be allocated to pre-screen and prepare produce for it to be usable for the robots, transforming parts of the job of a line cook from skilled (i.e., cooking

ingredients in the right way for the right duration) to unskilled or preparatory (i.e., peeling, cutting).

These issues then led to managers needing to re-evaluate job design, taking optimum human–robot cooperation into consideration. As stated by a hotel manager, the best way to use robots (in hotels) is to automate about 70% of the work and let employees easily finish the remaining 30%. He suggested that "*since the robots have already helped us, humans can just finish the remaining three parts without breaking a sweat.*" In these cases, while mostly responsible for relational tasks, employees take a supervisory role for machines and systems completing largely manual, procedural and transactional tasks. This finding supports the literature suggesting that the focus of automation has shifted from human substitution to human–robot cooperation (Decker, Fischer, & Ott, 2017). However, in some cases, tasks performed by employees are still the 'residual activities' of automated systems (Decker, Fischer, & Ott, 2017), instead of thoughtfully designed meaningful ones.

New jobs

Redistributing labor to best capitalize on human and robot capabilities one task at a time eventually leads to the transformation of entire roles, as well as the creation of completely new tasks and positions. Previous research has started to map out the types of tasks, skills, and ultimately, jobs, that are most prone to automation, as well as the ones that will prevail the longest (Huang & Rust, 2018). It is generally understood that jobs centered on creativity, emotional intelligence, or decision-making under uncertain conditions will be the hardest to automate, while jobs requiring precision, uniformity, pattern recognition, or extensive number-crunching under predictable conditions will be the easiest. For example, in a fully automated

coffee shop, a robot took care of all the procedural and transactional tasks (e.g., taking orders, dispensing food and beverages), whilst the job of a traditional waiter had been transformed to that of a technical supervisor who mostly looks after the robot remotely and focuses on finding ways to optimize the operations even further. The role of a receptionist had seen a similar shift, whereby most or all of the customer-facing tasks had been delegated to robots, leaving the now-jobless humans to supervise a fleet of robots and deal with glitches instead. Other completely new roles centered on technical expertise had emerged too, including data scientists and engineers specifically focused on automation in tourism. A robotics developer stated: "*Our view is very much use humans to do human specific jobs, and let's try and automate the mundane tasks. And that creates an environment where you have more interesting jobs for the people in the restaurants, and you're creating another layer of employment for people in maintenance, design, and operations of the equipment.*"

Smart materials and workplaces

Besides posing several changes to the nature and distribution of work, automation was also discussed to have implications on the workplace. A hotel manager suggested that "*even just the small things, like you know housekeeping has to remove the water stain from the… from the tiles every single time when they clean. If you could have some material,* […] *some material where the water* […] *stain doesn't stay there. That's a serious minutes."* In general, robotization of labor has been seen as a way to reduce jobs that are dirty, dull, or dangerous (Marr, 2017), thus contributing towards creating safer, more humane working conditions. For example, chefs working in high throughput restaurants (e.g., fast food) have to endure the extreme heat of combination ovens and grills that are always on, watch out for burns and oil spills, and often

breathe toxic fumes, all the while under mental and physical strain due to the hectic pace of incoming orders coupled with the need to stand all day long. Similarly, housekeepers often have to handle toxic detergents and operate heavy cleaning machinery whilst keeping up with high room completion targets. Research shows that both occupations are highly prone to workplace hazards and injuries (European Agency for Safety and Health at Work, 2004) and so there was consensus among managers of technology's role in alleviating these concerns.

Further impacts

The aforementioned outcomes of automation, indicating transformation of work, workplaces, and workforce, generate further impacts on employees, companies, and the sector or wider society. These impacts are largely stated as positive, although some remain a challenge for the tourism sector to address in the near future.

Impacts on employees. Due to the transformation in job design, which emphasizes human-robot cooperation, employees are believed to benefit from automation designed to remove friction from tasks, making for task completion with less effort. This is achieved by delegating to a greater extent mundane, repetitive, and dangerous tasks to machines and performing only the easier final steps in procedural tasks and/or concentrating on relational tasks. As put by a hotel manager: "*That's why it's good… that took out the admin tasks from their shoulders, they don't have to deal with that, you don't have to train them for that. They don't have to put together an invoice. It will be generated automatically to your email while you check out. So, they don't… they don't need to deal with that, so they really can focus on talking to the guests, spending quality time with the guests, offering restaurants, whatever… whatever they need."* Further, a

restaurant manager asserted that "*the machine takes care of dirty and dangerous work – humans the rest."* Combined with better working conditions due to the use of smart materials (e.g., a system that automatically contains and ventilates all kitchen fumes, providing greater safety and convenience for employees), an optimum level of human-robot cooperation in job design will result in more enjoyable work.

Moreover, integration of automation that results in minimal labor implies greater flexibility in roles and responsibilities of employees. Role changes and flexibility will lead to new skills requirements as employees are expected to handle a broad range of tasks and oversee various processes. A manager referred to their ideal employee as a *unicorn* and a *joy joker*, a person who does everything and creates a fun atmosphere. As put by a restaurant manager: *"I was watching the lady who was sort of hovering around interacting with the customers. And she was talking and smiling and joking, which is kind of something you never really had."* This highlights the emphasis on high-value tasks requiring cognitive/abstract and/or interactive skills (Autor, Levy, & Murnane, 2003) and confirms the transformation in roles of employees due to increasing use of technology in the workplace as conceptualized in previous literature (Bowen, 2016; Larivière et al., 2017).

Companies realizing the need for skills development often invest in personal development of their employees. These personal development practices include facilitating employee-led learning budgets and access to online training material through, for example, massive open online courses (MOOCs). As a consequence of acquiring diverse skills in the workplace, employees can afford opportunities to be promoted and advance their career faster. These qualities are consistent with aspects of decent work suggested by Dodd, Hooley, and

Burke (2019) and supporting Liebowitz (2010)'s suggestion of good people management practice in accommodating the needs of individuals within the organization.

Finally, employees working for an establishment with higher levels of automation will typically receive higher pay. A manager commented that *if you currently have a hundred people doing a task and 10% of those people are providing that authentic experience* […] *you would look at the whole 90% and see how is that automated, because that's actually not affecting the authenticity you're looking for. And then the people who are in the 10% can be paid appropriately, and paid properly because, actually, you're able to pay a certain amount of cost and I think that that's where it will happen…"* Managers from companies that have already implemented automation as well as those who are thinking of embracing more automation stated that due to new skills requirements as well as companies' ability to save costs from having minimal labor, they are/will be able to pay their employees more.

Overall, the findings pointed to the achievement of various dimensions of decent work as outlined by ILO (2019) and suggested in Baum et al. (2016), Ghai (2003), and Winchenbach et al. (2019): automation adoption results in work that provides good remuneration, supports health and safety, facilitates career development and hence income security, as well as freedom of association and the right to express views (e.g., through employee-led initiatives at work) for employees. However, these opportunities are potentially available to far fewer employees and only sub-sets of society, heightening concerns about widening gender and social inequality.

Impacts on companies. As elaborated previously, the main benefit of adopting human-robot cooperation in job design for companies is achieving operational efficiency and cost savings. Furthermore, a manager even emphasized that by focusing on increasing productivity and

efficiency in the sector through automation, the company is contributing directly to the sustainability of the sector as it faces challenges from labor shortage and higher demand (i.e., due to aging population). A hotel manager emphasized that "*…the idea of the* [Brand] *Hotel as a whole is to provide services at minimum labor, putting emphasis on productivity and efficiency. So, in that sense, I think we're already making a contribution* [to sustainability]."

Requirements in job design have direct impacts on decisions on types and functionalities of technological systems such as robots to implement as well as talent management due to skills requirements. The latter requires companies to implement different strategies in terms of hiring, training, and upskilling employees. Indeed, effective utilization of information systems and technologies, combined with human labor, has been suggested in the literature as key to achieve desired operational efficiency (e.g., Decker, Fischer, & Ott, 2017). In addition, the discussions here indicated that operational efficiency should include consideration for operational transparency, both at the business-to-business and business-to-consumer levels. For customers, companies should endeavor to make automation technology understandable, approachable, and unthreatening. In practice, this might mean carefully explaining how and why the technology is being used, as well as implementing such considerations to systems design (e.g., by retaining the line of visibility in the case of physical systems such as robots working in a kitchen). For other stakeholders, managers emphasized the importance of traceability and accountability as key in implementing novel technologies through disclosing and making public all information regarding supply chain management and partnerships. Overall, companies, particularly the pioneers in this space, reap the benefits of adopting automation through stronger competitive advantage and greater reputation.

Broader impacts. The effects of automation on displacement of labor (thus the need for re-employment) and the creation of new types of employment generate further impacts on skills requirements. This presents the need for equipping current and future workforce with skills relevant to AI-dominated economy (i.e. training, education), including in the tourism and hospitality sector. According to the skill-biased technological change model (Katz & Murphy, 1992), high-skilled workers are better able to adapt to technological change and to leverage technology to augment their work. Consequently, they are not easily replaceable by technology. However, the routine-biased technological change model (Acemoglu & Autor, 2011; Goos & Manning, 2008) suggests that the risk of displacement brought by automation cannot be attributed solely to the skill levels of employees, but to the complexity of tasks within their occupations (i.e. routine and non-routine manual tasks can easily be delegated to machines). Mounting empirical evidence in various studies supports the importance of upskilling as a way to mitigate risks of automation (Dobrusin, 2019; Hanuskek et al., 2015; Nedelskoska & Quintini, 2018). Nonetheless, Flynn and Wilson (2019) demonstrated that the labor market has been polarized with high-skilled and low-skilled occupations flourishing, while middle-skilled ones (those dominated by routine tasks) disappearing. The likelihood of finding new employment is thus higher in high-skilled and low-skilled occupations (Flynn & Wilson, 2019), further impacting education and training programs to focus more on non-routine abstract/cognitive (e.g., management) and non-routine service (e.g., caring and leisure) occupations. Thus, lifelong learning and reskilling on a society-wide scale is key to providing viable job transition pathways for all (WEF, 2018). The challenge to work design becomes to enable a transition from low skilled to higher skilled roles if the intervening middle skilled roles have been automated.

A restaurant manager offered his viewpoint on this: *"I think the responsibility for companies is really to help labor identify, here are the jobs that are going away sooner, here are the ones that are actually gonna be around a little bit longer, because it's harder for us to replace them with technology. And here are the new types of skillsets that are going to be required. And then I think it's the responsibility of labor to really take a hard look at itself and say, hey, like, this shift is happening… It's really hard and it sucks, but this is the reality and we need to face it together. You know, we're going to help you with this shift, we have a retraining program that we're going to put you through, we have a transition fund so that we're going to make sure you're okay in this change. We're going to help you through this shift, and put you in a position where a job is going to be around in the next 20, 30 years. And then I think the government is going to need to step in and help fund it all. And I think if we can take a more proactive approach, we can help soften the blow of this change."*

Managers also shared their views on who should be responsible for preparing for a more automated future, especially in terms of training and education, including reskilling and upskilling the workforce. Some strongly supported a shared responsibility between government and the private sectors, whilst others saw the responsibility lie primarily with individuals. As previously suggested, both the public and private sectors are called to work together to help workers to prepare, adapt, and transition to a more automated world; particularly for policymakers to invest in sustainable job creation and the provision of wider social protections (Benson Wahlén, 2019; ICAR, 2018; UNA-UK, 2018). Indeed, Brynjolfsson and McAfee (2014) suggest that the right policy levers will allow advances in technology to bring forth more creative work and grow sectors that are less susceptible to automation.

A Model of Decent Work through Automation

An important question this research attempted to address was whether and how automation can be adopted to promote the provision of decent work in travel and tourism. Based on the findings, a model outlining how to provide decent work through the adoption of automation is suggested (see Figure 2). Three factors contribute to this: (1) effectiveness of human-machine cooperation, (2) working conditions, and (3) level of empowerment. The operational property of these factors can be defined in terms of their measurement levels (i.e., ineffective–effective human–machine cooperation, bad–good working conditions, low–high level of empowerment) and reflected through several relevant indicators. It is important to note that while the findings suggest that promoting decent work was not the aim of most implementation of automation in tourism to date, this model was developed from managers' descriptions of the normative, positive outcomes of the implementation.

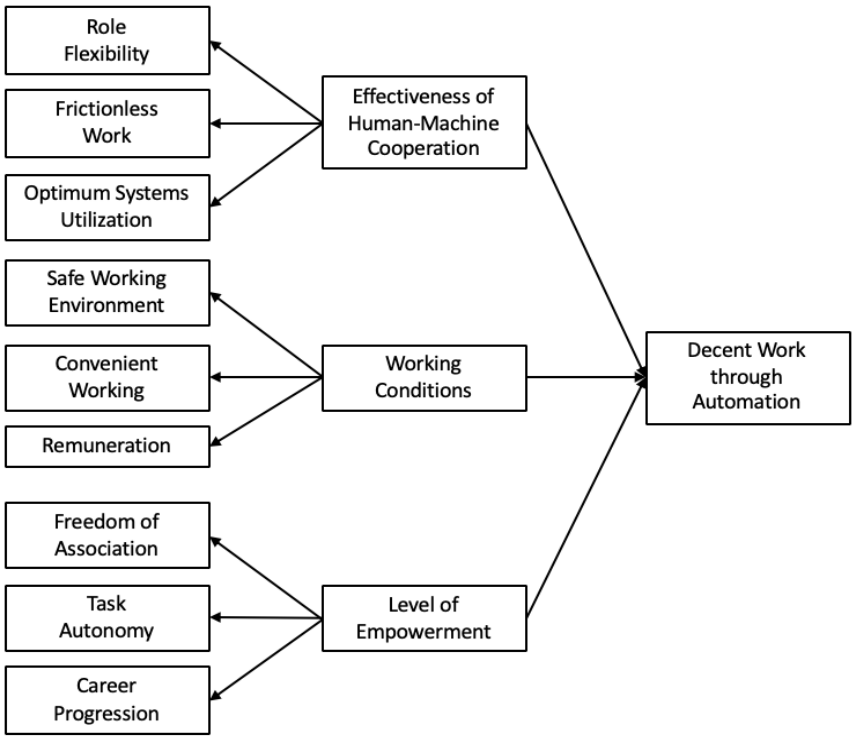

Figure 2. 'Decent Work through Automation' (DW–A) Model

For employees, an effective human–machine cooperation means tasks are distributed to machines and employees in order to support employees' role flexibility (i.e., interesting variety of work), facilitate frictionless work (i.e., employees being responsible for high value tasks), and allow for technological systems to function at optimum capacity (i.e., a higher level of systems utility). This employee-centered view of human–machine cooperation emphasized the need for automation to be implemented in a complementary instead of substitutional relationship with employees (Decker, Fischer, & Ott, 2017), signifying the approach to placing human at the center of automation design (Navarro, 2017). This is in line with Hoc (2000; 2001) who sees human–machine cooperation as actions of an agent of the human–machine system with intent to facilitate the task of the other agent and/or a common task. To achieve desired performance of a complementary human–machine system (i.e., role flexibility, enjoyable work, optimum system utilization), the findings in this study suggest that it is not always necessary for the system to mimic human–human cooperation, nor for the machine to model humans (e.g., service robots to mirror, thus substitute, employees). Instead, the key to providing decent work is in task allocation that gives employees meaningful, flexible, and high-value tasks and roles.

The second factor, working conditions, can be expressed through a safe working environment, convenient working, and fair wages. These reflect the International Labour Organization (ILO, 2017)'s indicators for working conditions, which include frequency rates of occupational injuries and average wages, along with other governmental commitment measures such as level of national compliance of labor rights (including freedom of association and collective bargaining, categorized herein as indicators of empowerment at the firm level). In particular, the delegation of dirty, dull, and dangerous jobs to intelligent machines is seen to reduce occupational diseases (e.g., acute trauma, musculoskeletal disorder) and reduce the

chances of hazards and accidents (e.g., spills, burns, slips) in the workplace. An indication that employees in automation-dominated service feel rewarded as a result of automation is being paid higher wages compared to their peers as a result of lower labor costs (relative to capital investment). As suggested by Baum et al. (2016), much tourism employment includes poorly paid work in poor working environments. This model hence formalizes ways to assess the quality of working conditions in tourism brought by automation.

Finally, the level of empowerment through automation can be reflected by the degree to which employees are empowered in terms of task fulfillment, personal development (e.g., upskilling), and career progression. Through the combination of minimal labor (a small number of employees), task changes, and role flexibility, employees in automation-dominated services are empowered to take charge of coordinating process improvement and skills development. By continuously developing skills as they oversee various processes and performing a wide spectrum of tasks, employees are empowered for faster career progression. The findings highlight the empowerment practice around task autonomy, self-management, and upward problem solving (Wilkinson, 1998). As automation transforms the nature of their work, employees have more opportunities to be involved in participative decision making, taking on wider responsibility for work performance (i.e., through human–machine cooperation), service improvements, as well as own or group's skills and career development.

Following the themes extracted from the data, several observable manifestations of each indicator are suggested (see Table 1). For example, optimum systems utilization, an indicator of effective human–machine cooperation, can manifest in systems–task fit (i.e., the extent to which the systems fit the allocated task), performance level (i.e., the extent to which the systems perform at desired levels), proneness to errors and breakage (i.e., the extent to which the systems

are prone to errors and breakage), and maintenance requirement (i.e., how often the systems need to be checked for maintenance). These observable manifestations can be developed into measurement instruments to validate the model through quantitative inquiries.

Table 1. Factors contributing to 'Decent Work through Automation'

Factor	**Indicator**	**Observable Manifestation**
Effectiveness of human-machine cooperation	Role flexibility	Task variation (the extent to which tasks allocated to employees are varied) Flexibility in task completion order (the extent to which the order of task completion is flexible)
	Frictionless work	Simplicity of task (the extent to which tasks allocated to employees are easy to complete) Value of task (the extent to which tasks allocated to employees are of high value) Cognitive task (the extent to which tasks allocated to employees require higher-order thinking) Social-relational task (the extent to which tasks allocated to employees require social-relational skills)
	Optimum systems utilization	Systems-task fit (the extent to which systems fit for the allocated task) Performance level (the extent to which systems perform at the desired levels) Proneness to errors and breakage (the extent to which systems are prone to errors and breakage) Maintenance requirement (how often systems need to be checked for maintenance)
Working conditions	Safe working environment	Frequency rate of injuries Frequency rate of incidents of occupational hazards Frequency rate of incidents of occupational disease
	Convenient working	Workplace convenience (the extent to which workplace is arranged to facilitate convenient working) Smart workplace materials (the extent to which workplace is using smart materials)
	Remuneration	Average wage rate Attractiveness of benefit package (the extent to which employer offers attractive benefits such as healthcare and retirement)
Level of empowerment	Freedom of association	Freedom of association (the degree to which employees are free to join or leave a group and to take collective action to pursue the interest of group members)
	Task autonomy	Task autonomy (the extent to which employees are free to make decision on allocated tasks, such as to improve existing process)
	Career progression	Speed of career progression (the extent to which employees can swiftly advance their career [move vertically] within the organization through internal promotion)

Overall, the model explains whether the adoption of automation contributes positively to the provision of decent work for tourism employees. It therefore contributes to the overall assessment of the economic and societal benefits of automation in the travel and tourism sector. More importantly, the model provides a theoretical foundation, derived from multidisciplinary perspectives (i.e., human resources/talent management, human–computer interaction, human–machine cooperation, tourism and hospitality management), to further assess the extent to which each of the identified factors contribute to 'Decent Work through Automation' (DW–A) and thus informs the steps to assess its application through empirical studies in different service contexts. As such, this study opens a pathway for further studies on the human development aspect of automation within and outside of the travel and tourism sector.

Conclusion and Implications

In order to assess whether the implementation of automation in the travel and tourism sector has been made in a responsible and accountable manner with regards to dignified work, this study aimed to explore and conceptualize how automation affects work in the sector, particularly focusing on the role of automation in supporting the provision of decent work. Based on in-depth interviews and focus group discussions with managers of relevant tourism and hospitality businesses, this study produced rich descriptions of factors influencing adoption of automation, the impacts of doing so, and a conceptual model explaining how automation can support the provision of decent work. Thus, this study contributes theoretically and practically to the conceptualization and the overall assessment of responsible and accountable automation in tourism.

Adoption of automation was largely seen as the company's answer to labor shortage, or ability to reduce labor costs and so producing a more efficient operation. Automation was thus seen in a substitutional relationship with employees. This is further emphasized by the effects of automation on distribution of tasks, where in some cases human–robot cooperation (representing a complementary relationship between machines and human labor) was a product of technical limitations (e.g., robots cannot perform 100%) rather than a thoughtful job design. Displacement of workers and new jobs were also recognized as the first round of impacts of automation. In addition to having more meaningful and frictionless (easier) tasks and more flexible roles, receiving higher remuneration, and getting promoted faster, employees also benefit from safer and more convenient working environment. The first round of impacts of automation (displacement of workers, new jobs) generated further implications due to skills requirements for existing and new workers, as well as those in transition who need reskilling or upskilling through education and training programs.

This study contributes to the literature by proposing a model to explain how automation can play a role in promoting decent work, hence contributing toward human development and sustainability. Several research questions put forward by Ivanov and Webster (2019b) are addressed by this research, including robots' impact on operations and productivity for the companies, as well as whether robots are substitutes or complements of human labor. This study also addresses research challenges suggested by Baum et al. (2016) around workforce consideration in sustainable tourism, albeit not discussing the issues at the destination or national level. For further research, the model provides potential measurements to assess 'Decent Work through Automation' through empirical studies involving different concepts in the fields of people management, such as performance, job satisfaction, career satisfaction, turnover

intention, corporate citizenship, and organizational commitment, as well as employees' attitudes toward automation and technological changes in general.

This study also provides practical guidelines on work design and task allocation proven effective for optimal human–robot cooperation in the sector. Learning from these early adopters, those interested in new business ventures in the sector should assign meaningful roles and tasks to complement human labor with machines, delegating mundane, repetitive, and dangerous tasks to machines and allowing employees to take the supervisory roles and/or to focus largely on relational tasks. This also leads to a practical guideline on systems design, emphasizing the need for technology-task fit and the advantages of using single-purpose machines for simplicity and ease of maintenance. Those implementing automation in the sector are new companies and spin-offs from larger, more experienced companies, demonstrating that automation was adopted for business model innovation instead of mere operational improvement. This will be helpful to those starting up new services.

This study informs policymakers by proposing pathways to responsible adoption of automation through the promotion of decent work in the travel and tourism sector. As suggested, automation will result in displacement of workers, but for those who stay (or find new jobs) in the sector, automation can support safe, stable, well-paid, and more enjoyable work. This study further suggests the importance of shared responsibilities amongst workers, companies, and policymakers to plan for upskilling, reskilling, and education, preparing the workforce to take on new opportunities presented by AI and robotics revolution, and investing in sustainable work. As the rate of automation will increase in the future, presenting greater challenges to most, a more accurate assessment of impacts will be needed to create actions to identify and achieve a desired future of automation.

As with all research, there are limitations to this empirical study. Even though the sample used here spanned four countries and three continents, it only included developed economies, most likely exacerbating the issues around labor shortage. Given the well-established relationship between technological progress and economic growth (e.g., Schumpeter, 1983), it is expected that developed nations transition to automation sooner than their developing counterparts. Indeed, most (if not all) examples of automation in tourism and hospitality have emerged in relatively similar economic conditions. This highlights the importance of the current study. However, as automation efforts inevitably scale-up across increasingly diverse markets, research should look into establishing a more holistic, and thus generalizable, view on decent work in hospitality and tourism in the 21st century and beyond.

Finally, this study took a purely managerial view, looking into drivers and impacts of automation against the backdrop of decent work in tourism and hospitality. However, of equal importance would be to examine the extent to which these strategies actually influence the wellbeing of employees and the implications for broader society. Future research should therefore endeavor to better understand how employees perceive the transition to more automated processes in cases where automation is adopted in existing service operations. Previous studies have looked at how technostress (i.e., the stress associated with the introduction of new technology) affects organizations and individuals (Ioannou & Papazafeiropoulou, 2017). Like previous technologies, it is highly probable that automation will entail technological anxiety and angst, especially given its unusually pervasive nature. This anxiety may also be confounded by perceived intelligence and agency of AI systems (autonomy, proactivity, reactivity), creating further psychological strains for employees working alongside or supervised by AI agents.

Effective ways of mitigating and managing the transformation are needed to ensure technology serves the wellbeing of people, and not the other way around.

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x=(tourism_work) y=(sdg8) while y=true: automate(x)

Supplementary Materials

A. Interview Guide Questions

(a) what prompted the company to adopt automation

- What are the main reasons why your [company] adopted robotics/automation?
- What are the target outcomes of implementing robotics/automation? Explain.
- Why do you think a robot hotel/restaurant was a good idea?
    - Do you think robotics is more advantageous than any other technologies?
    - Do you think robotics is compatible with the service processes in the [company]?
    - Do you think robotics technology is complex/easy to manage?

(b) how processes and operations have been transformed

- How long have you implemented robotics/automation?
- How successful do you think the implementation is in achieving the target outcomes?
- In general, do you think the implementation of robotics/automation has changed the nature of service processes/operations and experiences? If so, how?
- Have you encountered any issues from customers and/or any technical issues?
- If so, how did you manage to solve the issues?

(c) how the roles of employees have changed

- How many employees do you have [working in the property]?
- Has there been a change in the roles of employees [considering automation]?
- Have you encountered any issues from employees?
- If so, how did you manage to solve the issues?

(d) what company's visions are for the future

- How would a hotel/restaurant in 2038* be like? How do you envision managing a hotel/restaurant in 2038*? –*20 years in the future

B. Code Book

Level 1 Code	Level 2 Code	Code Name	Definition	Sample Quote*
A		Displacement of workers	Automation substitutes/replaces human employees; automation replaces all tasks	"*So, in a five-star hotel you're always going to have to have people behind the desk and you'll have to have that formal check-in process, but for three-maybe even early four-star hotels, that's going to be ever changing and you'll be able to eliminate, maybe not all of them, but the amount of people that are behind the reception desk. So, we work with all the major brands and they're investing millions into this technology, which hopefully we can adopt when we open our new properties*." – Hotel Manager, UK
B		Job design: human–robot cooperation	The distribution of tasks to robots or automated systems and human labor for an effective human-machine collaboration; automation replaces some (but not all) tasks	"*It's the same for robots. At first I had high expectations for the cleaning robots, that it would do everything perfectly, but then I realized there was trash left behind. I thought about it and changed my way of thinking, that letting the robots do half the work humans used to have to do will help cut down a bit the time humans spent cleaning. You just have to try it to know it.*" – Hotel Manager, Japan
C		New jobs	The creation of completely new tasks and positions	"*Our view is very much: use humans to do human specific jobs, and let's try and automate the mundane tasks. And that creates an environment where you have more interesting jobs for the people in the restaurants, and you're creating another layer of employment for people in maintenance, design, and operations of the equipment. So effectively we're up-skilling the required labor in restaurants. Both in the restaurants, the waiting staff and the food preparation staff, and then the demand that we're creating for both skilled and semi-skilled operatives, service and maintenance people who work with more complex machines*." – Robotics Developer, UK
D		Smart materials and workplaces	The use of smart technology to engage employees with their working environment	"*So, with systems now whereby the room attendant knows that that person has checked out and that room is available and they're not in the room and they can go. And what that does is that gives them more time in the room, which makes the job physically easier because they've got more minutes in the room. So instead of having 30 minutes with waste of travel time, you have 30 minutes dedicated in the room so by that very nature, you can get a better product, you may be spending 10% more time physically in rooms so therefore, your productivity hasn't changed, you're delivering a better product and more time to prepare.*" – Hotel Manager, UK
E		Further impacts	Second round of impact of automation	
	E1	Impacts on employees	The effects of adoption of automation on human employees, such as role flexibility, wage, and career progression	"*That's why it's good… that took out the admin tasks from their shoulders, they don't have to deal with that, you don't have to train them for that. They don't have to put together an invoice. It will be generated automatically to your email while you check out. So they don't… they don't need to deal with that, so they really can focus on talking to the guests, spending*

Level 1 Code	Level 2 Code	Code Name	Definition	Sample Quote*
				quality time with the guests, offering restaurants, whatever… whatever they need." – Hotel Manager, Hungary
	E2	Impacts on companies	The effects of adoption of automation on companies, such as cost savings	"*…the idea of the* [Brand] *Hotel as a whole is to provide services at minimum labor, putting emphasis on productivity and efficiency. So in that sense, I think we're already making a contribution* [to sustainability]." – Hotel Manager, Japan
	E3	Broader impacts	The effects of automation on broader society, such as skills requirements and the need for upskilling/reskilling workers	"*I think the responsibility for companies is really to help labor identify, here are the jobs that are going away sooner, here are the ones that are actually gonna be around a little bit longer, because it's harder for us to replace them with technology. And here are the new types of skillsets that are going to be required. And then I think it's the responsibility of labor to really take a hard look at itself and say, hey, like, this shift is happening… It's really hard and it sucks, but this is the reality and we need to face it together. You know, we're going to help you with this shift, we have a retraining program that we're going to put you through, we have a transition fund so that we're going to make sure you're okay in this change. We're going to help you through this shift, and put you in a position where a job is going to be around in the next 20, 30 years. And then I think the government is going to need to step in and help fund it all. And I think if we can take a more proactive approach, we can help soften the blow of this change."* – Restaurant Manager, US

*The same quote may represent multiple codes.