Chapter 10
Shaking Up the Status Quo? An Analysis of Developments in the Social Context of Work Stemming from Industry 4.0

M. Habraken, T. Bondarouk and D. Hoffmann

Abstract During the past years, academics have revised their earlier decision to omit the social dimensions of work from work design theory, realising that interpersonal interactions in the work setting are becoming more pervasive. Industry 4.0, however, raises new question marks with respect to this pervasiveness. Terms such as big data, Internet of Things and augmented reality have the potential to lead to shifts in the status quo of the social context of work and implicit issue of thriving. This chapter therefore aims to analyse what developments can be observed with respect to the social context of work as a result of industry 4.0. Findings from thirteen interviews conducted in four different organisations at two levels suggest that social interactions will not give into digital options. More importantly, they provide a wake-up call regarding the adoption of industry 4.0 and highlight two ways in which it influences the social context of work and human thriving.

Keywords Industry 4.0 · Social context of work · A two-way influence · Thriving

10.1 Introduction

Publication titles such as 'The future of employment: how susceptible are jobs to computerization' (Frey & Osborne, 2013), 'The future of human work is imagination, creativity and strategy' (Pistrui, 2018) and even well-known sayings like 'Choose a job you love and you will never work a day in your life' highlight the fact that when addressing influences on or consequences of work, we often tend to consider work from a content point of view. Yet the social context which surrounds work—defined as 'the interpersonal interactions and relationships that are embedded in and

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influenced by the jobs, roles, and tasks that employees perform and enact' (Grant & Parker, 2009, p. 322)—plays an essential role as well.

Statistical support for this fact can be found in the results of the meta-analysis by Humphrey, Nahrgang, and Morgeson (2007), which show that social characteristics explain a considerable amount of unique variance in behavioural and attitudinal outcomes beyond the task and knowledge dimensions of work. Academics even revised their earlier decision to omit the social dimensions by recognising that interpersonal interactions embedded in the work setting are increasing in pervasiveness within contemporary organisations (Grant & Parker, 2009; Oldham & Hackman, 2010).

Technological developments—labelled under the heading industry 4.0 and supplemented by various editions in different countries—facing us at the moment could bring a halt to this observed pervasiveness of social interactions, however. In other words, the far-reaching digitalisation that underlies terms such as big data, Internet of Things and augmented reality has the potential to lead to shifts in the status quo of the social context of work. The huge amounts of data that can now be generated can, for instance, serve as a new source of knowledge for employees. Whether used as is or analysed, this data can be delivered to employees by means of apps, screens or other devices. As a result, employees can obtain performance feedback straight from the data. This would change the way feedback is given and received and puts the use of feedback from others in a new light.

Another frequently addressed expectation of industry 4.0 is the realisation of connected factories. The prediction is that industry 4.0 will result in far-reaching supply chain cooperation. This signals the introduction of more interaction, but the question is to what extent are those interactions interpersonal; much of this increased interaction could take place digitally via communicating systems/devices. Signs of a lesser extent of social communication are already visible when looking at results from an online survey conducted by Randstad in 2016 among employees[1] in 34 countries. Their data showed that globally, 46% of the respondents agreed that they have fewer personal interactions with their colleagues due to technology. Conversely, the same survey showed that 89% of the participants believed that a face-to-face meeting is the best way to interact with someone (Randstad, 2016). A reasonable question to ask would thus be where are the interpersonal interactions and relationships of work heading to in the context of industry 4.0? Are we communicating less and less socially or does a smart supply chain create more social interactions with suppliers?

These questions guide our inquiry in this chapter that aims to analyse what developments can be observed with respect to the social context of work as a result of the industry 4.0 work context. We begin by defining this phenomenon and the adopted interpretation of the social context of work. We then move to the outline of the research process, after which we present the results from the interviews conducted. Next we discuss academic and practical consequences of the observed developments and provide a synopsis of key insights. Finally, the limitations are addressed, and we end with a brief conclusion.

[1]These employees were: not self-employed, aged between 18 and 65 and worked a min. of 24 h a week.

10.2 Industry 4.0

When reading about the concept industry 4.0, we cannot escape the connection with the term 'Fourth Industrial Revolution' as it is, quite literally, built into the concept of industry 4.0. That is, the 4.0 designation signifies it as being the successor to the three earlier industrial revolutions. This connection probably helped ensure the massive interest that now surrounds industry 4.0. Consider, for instance, the amount of media attention, the number of conferences on this topic as well as the conversations it has sparked within organisations. The popularity of industry 4.0 did not prevent the emergence of a discussion on its meaning. In other words, the absence of a clear understanding of the label industry 4.0 is an issue which has been voiced in recent scholarly publications (e.g. Hermann, Pentek, & Otto, 2016; Liao, Deschamps, Loures, & Ramos, 2017; Reischauer, 2018). Several papers have even addressed this issue, yet a comparison between, for instance, the work of Hermann et al. (2016), on industry 4.0 design principles, and the perspective taken by Reischauer (2018) of industry 4.0 as a policy-driven discourse does not seem to show much unity in how to understand the label. We elaborated on the link between these two seemingly diverse standpoints that can be found in research about smart industry, which is the Dutch equivalent to the more common label industry 4.0 (Habraken & Bondarouk, forthcoming).

The data in this study, obtained via interviews with smart industry experts, led us to develop two distinct components to represent the term smart industry: a communicative bubble and a platform for the multiplicity and complexity of current developments. The first component depicts the human desire to create a way to communicate a sense of importance with respect to the observed technological advances, hence to promote innovation. This component overlaps with the viewpoint presented by Reischauer (2018, p. 26) to consider industry 4.0 as a 'broader communicative action that mobilizes actors to innovate collaboratively and that is driven yet not determined by politics'.

The latter component, a platform for the multiplicity and complexity of current developments, fits with the design principles discussed by Hermann et al. (2016). This component implied that smart industry can be considered as a 'platform expressing three technology-based developmental streams that exist at the moment: (1) the establishment of connections between devices and/or systems within firms and with external parties worldwide; (2) the ability to take more advantage of the value of information through the presence of greater amounts of data; and (3) the availability of contemporary physical and non-physical assets' (Habraken & Bondarouk, forthcoming). All three streams have a digital aspect imbedded within them. The platform component further entails that the application of these three streams is restricted by several constraints, such as access to required skills or supporting infrastructure. Given the goal of this study, we represent industry 4.0 only by means of its platform component. In other words, we focus our attention on the three technology-based developmental streams—connected, informed and equipped. Finally, in general, we adopt the term industry 4.0 throughout this chapter, but on occasion the label smart

industry is used since our data were collected in the Netherlands where industry 4.0 is known as smart industry.

10.3 The Social Context of Work

After we clarified our view on industry 4.0, we turned to the social context of work, a job design category that has had a turbulent history. Job design researchers initially took social dimensions into account, as evident from the assessment of the extent to which jobs involved dealing with others, friendship opportunities, required interaction, interaction opportunities or feedback from others (Hackman & Lawler, 1971; Hackman & Oldham, 1975; Turner & Lawrence, 1965). Yet the job design theory introduced in Hackman and Oldham (1976) omitted any signs of these social dimensions, and they disappeared from general theories and research programmes on job design. Academics today, however, recognise the importance of the interpersonal interactions embedded within the work setting. Oldham and Hackman (2010) even went so far as to state that their earlier judgement call, neglecting the social dimensions of work, was quite short-sighted.

Within this study, we adopt the social work characteristics used by Humphrey et al. (2007) since they are now well-established (see Grant, Fried, & Juillerat, 2011; Morgeson, Garza & Campion, 2013; Morgeson & Humphrey, 2008). The four social work characteristics that are taken into account are: (1) *feedback from others*, 'the extent to which other organisational members provide performance information'; (2) *social support*, 'the extent to which a job provides opportunities for getting assistance and advice from either supervisors or co-workers and includes friendship opportunities on the job'; (3) *interaction outside the organisation* is 'the extent to which a job requires an incumbent to communicate with people (e.g., suppliers or customers) external to the organization' and (4) *interdependence*, 'the extent to which a job is contingent on others' work and other jobs are dependent on the work of the focal job' (Humphrey et al., 2007, p. 1336). By focusing on these four social characteristics, the less prevalent social aspects such as goal interdependence, outcome interdependence or contact with beneficiaries (Morgeson & Humphrey, 2008; Grant et al., 2011) are neglected. Consequently, to prevent another short-sighted judgement call, these dimensions were kept in mind in case they were raised during discussions on interdependence or interaction outside the organisation.

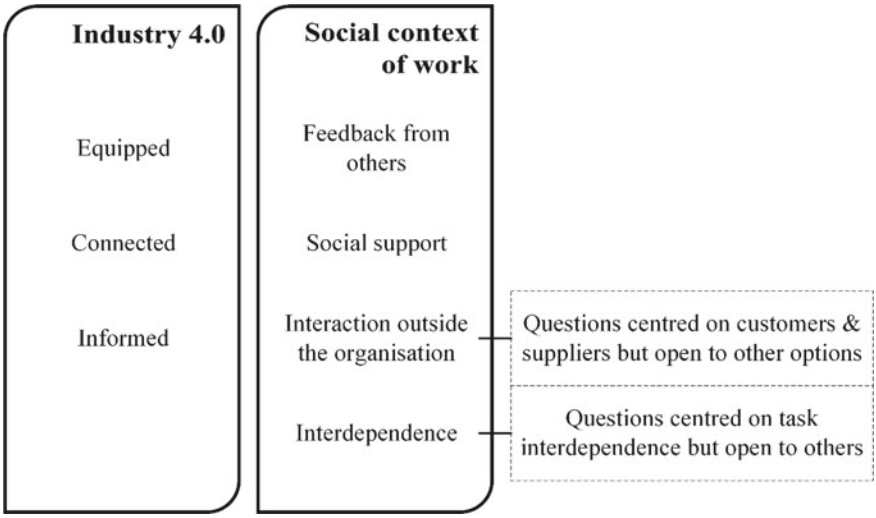

Fig. 10.1 Summary of the theoretical part. Based on Habraken and Bondarouk (forthcoming) and Humphrey, Nahrgang and Morgeson (2007)

Before continuing to the discussion of our method, Fig. 10.1 summarises the above two sections.

10.4 Method

10.4.1 Procedure

An essential prerequisite for answering our research question was the presence of industry 4.0 within the organisations in which our interviews would be conducted. Consequently, two sources were used to search for suitable organisations within the Netherlands: the Smart Industry and Human Capital research group at the Saxion University of Applied Sciences and the national Dutch smart industry website, specifically their list of ambassadors. Smart industry ambassadors are companies and institutions that are 'ready for the future and actively contribute to the realisation of the smart industry action agenda' (Dutch smart industry team, n.d.). To ensure consistency among the selected organisations, only those operating in the manufacturing industry were approached. Seven firms were willing to participate in our research. Based on an initial consultation with these companies, four were selected. The selection criteria applied were: the integration of smart industry and the availability of appropriate respondents. For instance, one organisation was willing but busy at the time of data collection which led to the unavailability of targeted participants. In

addition, another firm stated the use of far-reaching technology, yet this technology was already in use for 20 years and thus not considered smart enough.

The four selected organisations were a company that develops and manufactures mass flow metres, one that produces power management products, and two technical service providers that are active in the manufacturing industry. The interviews within these firms were semi-structured, face-to-face and took place in the summer of 2018. All interviews were digitally recorded and transcribed verbatim. At the end of the interviews, respondents were offered the opportunity to provide feedback on their answers. None of the respondents, however, made use of this possibility.

By selecting cases as well as respondents (see participants) in a purposeful manner, by offering respondents the opportunity to offer feedback and by going over transcripts multiple times, within each step, to prevent any oversights as well as incorporate independent analyses by external assessors (see data analysis), we ensured the rigour of our qualitative findings in line with the trustworthiness criteria indicated by Guba (1981).

10.4.2 Participants

Interviewees were selected on the basis of the extent they come into contact with smart industry technology. A choice was also made to select respondents from two hierarchical levels—employees and supervisors (supervisors were direct manager of employees). This distinction was made as we wanted to look at the influence of industry 4.0 on social characteristics of work which encompass the interaction between both levels. In three cases, one manager and three employees were interviewed, while in the remaining case two managers and two employees were approached. Respondents were asked to address changes related to the four social characteristics of work, and thus interviews consisted of the following main topics derived from the literature: feedback from others, social support, interaction outside the organisation and interdependence. Respondents were asked to reflect on the mentioned changes with regard to the role of smart industry technology (see Appendix for the interview protocol).

10.4.3 Data Analysis

The analysis of the transcripts took place in several rounds. During the first round, handwritten memos were made for each interview that summarised the social topics being addressed in a few sentences (e.g. importance of collaboration, presence of verbal agreements or increasing customer specifications). This process provided insights into the social aspects being discussed within the interviews. Next, the transcripts were looked at from a more technological point of view. In other words, memos were made that highlighted any technological developments raised in each

interview. This ranged from very abstract acknowledgements such as the current complexity of technology to more concrete developments like 3D printers, robots or sensors.

Handwritten memos were again used during the third round, but this time the analysis took place at the level of an organisation instead of a specific interview. The aim of this third round was to establish connections between the input from the previous two rounds. Given the complexity of this process, external assessors were contacted to look at the transcripts and offer their opinion on the connections between the mentioned social dimensions and technological developments. Four contacts responded to our request, which resulted in eleven of the thirteen interviews being reviewed by two separate people. As these external assessors did not indicate any surprising findings (i.e. no insights that were not already known), an additional attempt to seek a second assessor for the remaining two interviews was not undertaken.

Two final rounds were conducted to combine the previously obtained input at the type of organisation level (technical service provider versus production organisation) and at the overall level. With respect to the last round, a check was performed to determine whether there were any observed findings that could be detected in both types of organisations.

10.5 Findings

10.5.1 External Collaboration—Customers

One of the most frequently addressed external parties in interviews with both types of organisations was the customer. A particular topic was that a more customer-centric approach was being adopted nowadays. Although we could not find a clear link with current technological developments for this observation, the fact that this topic was so prominently visible makes it worth mentioning. A noticeable aspect was that the increase in customer-specific products did not lead to drastic changes for the production organisations. In other words, interviewees stated that contact with the customers was mainly maintained by a sales or service department and by engineers who assisted from a technical standpoint, while staff on the shop floor never communicated with customers. Another interviewee indicated an absence of communication between the production and the service departments. In other words, production was not informed about customer orders that were returned. This is an important statement considering the growing move towards customer-specific production.

The shift to an increasingly customer-centric approach did result in changes to the social context of work within the two technical service providers. Besides technical motives, the possibility to be more customer-oriented was given as a reason for the transition to teams (more details are discussed below). The data from the technical service providers showed that engineers at all levels now have contact with the customer; a project manager (i.e. a senior engineer) is tasked with customer relations

and presents a fixed point of contact, while the junior and mid-level engineers discuss technical specifications. One project manager stated, for instance, that 'I am not the translator. We try to put the programmers as close as possible to the customer since customer contact can best be placed with people who know how to make things. We leave a lot to the programmers, who talk with the customer about what they want, and I have a steering and coordinating role' (R2).

This finding could have stemmed from technology since respondents in general addressed the breadth and complexity of technology which fits this change. On the other hand, the previous respondent mentioned that it is not desirable to have the programmers wait patiently to get a project assigned, while a statement from another interviewee signalled that customer preference could be a reason—'when you ask companies what they prefer, they say that they want a fixed point of contact, but also closer connections with the person who builds the machine' (R6). Besides an increase in the extent of contact, one interviewee from a technical service provider highlighted a change in whom you work with regarding customers—'you see that the client has his own programmer and says we want to develop something together. Then we are not just a supplier, we also provide knowledge to that programmer. You share knowledge, and you work together on the product which is then theirs. You see all kinds of collaborations emerge' (R4).

10.5.2 External Collaboration—Suppliers and a Lending Structure

The communication with suppliers was a topic mentioned less by both the technical service providers and the production organisations. When suppliers were mentioned, it was often in association with common types of interactions such as gaining support, for instance, via email or Microsoft support platforms, or in connection with supply rejections. An exception to the above interactions, which do not reflect industry 4.0-related developments, is highlighted by the following quote: 'Bosch has obliged their suppliers to place barcodes everywhere so that everything is registered. The entire tracking and tracing process has been optimized in that organisation. Their suppliers must cooperate in this. As a result, you see that cooperation is becoming more and more intensive' (R4).

Besides customers and suppliers, a new source of external collaboration was observed: 'in the past you sometimes delved into a field of knowledge in order to gain some experience, to understand or become better at it. Nowadays that does not work anymore. This is our field and we should not concern ourselves with other aspects. We now seek out a colleague for that, or if we do not have one we find a partner [could be a conculega[2]] that has the knowledge we are after' (R4[3]). In

[2]Implies a colleague from a competitor.

[3]We are aware that this respondent is used quite often in our discussion of the results. This interviewee, however, mentioned interesting yet unique insights. Likely as a result of his function and

short, this respondent from a technical service provider expressed the fact that they hire engineers from external organisations, for brief periods such as a day, and also stated that competitors hire his own engineers when specific knowledge is absent. The flexibility of such a construction lies in stark contrast to a statement from one of the production organisations—'we do not share information with our competitors' (R10).

10.5.3 Internal Collaboration—Technical Service Providers

Within both technical service providers, the most prominent development was the observed shift towards operating in self-steering, multidisciplinary teams on the basis of an agile scrum method. This method entails sprints of approximately three weeks, according to interviewees, and once or twice a week the status of the current sprint is discussed—'you ask once a week which points are finished, which are not finished and what could have been better or different. For example, we do not have that facility or it does not work; what is the problem so that we can try to solve it' (R1). The extent of collaboration is further highlighted by the quote: 'we work in a team, a scrum team which is totally non-hierarchical. I would not know who I should see as my boss … it is really collaborative how we decide to address things' (R5). These indications of collaboration concern how a sprint or the overarching project is tackled. With regard to once individual tasks, an engineer stated that he mostly works independently. This is emphasised by the order of sources that the same respondent mentioned when seeking help: search the Internet, go to a colleague and, if nothing else works, find an external party.

The newness of this multidisciplinary scrum team approach became clear as interviewees mentioned they are heading more towards teams or that they are still working on that transition. In addition, and more importantly, a link with technology was made—'I think technology has played a very big role in this. The hardest part is always, when do you think you are ready? If you do something straightforward, it is fairly easy to estimate how much work I still have to do. But it is becoming more complex and interconnected and then that question becomes more difficult. In a group you have several people who look at the estimated amount of work and then you notice that the estimate is more accurate. The process and the monitoring of a project can now be done better' (R2) *and* 'I think the technology is driving that because you have to be more flexible, and you have to know a lot more things. So that means that you need your colleagues much more. Technology is getting increasingly complex and is broadening … you need the other disciplines in order to offer a total solution to customers' (R4). In short, as pointed out by one interviewee, an

location: 'I started as an ordinary software engineer and quickly became a lead engineer. From 2011, I am a bit of a project leader. Initially, we call our team "I IT" which stands for industrial IT—not the standard industrial automation but the layer above it. We deliberately called our team smart industry because we have a lot to do with that' (R4).

individualistic approach no longer works in times of industry 4.0. You have to work together and share knowledge. A self-steering, multidisciplinary team structure thus seems to be the solution for this issue. As a result, the following information came as a surprise—'the team I work in is composed solely of software engineers. Most of our teams encompass nearly all disciplines, only we as software engineers have our own team. We do this very consciously because technologically wise, it all goes so fast for us. To keep up, we have to share knowledge and we, in turn, deliver our knowledge to all those other teams. That is a bit of a twist' (R4). It shows the need to find a balance between better information sharing between disciplines, on the one hand, and maintaining the exchange of knowledge with employees of the same discipline on the other.

10.5.4 Internal Collaboration—Power Management Production Firm

An aspect which stood out in the power management production organisation was the recurring mention of the tiered structure for internal communication used within that specific company. This structure implies a layered approach towards communication: tier 1 is the communication between a supervisor and his/her employees, tier 2 is between supervisors and tier 3 includes the management level. Despite its frequent mention, its newness was questionable and there is no connection with industry 4.0. One interviewee specifically pointed out that he did not think technology played a role in the emergence of the tiered structure. Respondents also discussed a lot of software applications such as SharePoint or Apex. The introduction of these systems started 18 years ago. Though they signal a digital approach, they are not new advances. A statement that did display a link with new technology, because it showed overlap with augmented reality possibilities, was: 'what we are looking at now, but that is not there yet, is how can we do things differently on the shop floor? For example, can we work with light or signals instead of work instructions?' (R11). The respondent indicated that it would likely require a completely different type of employee and that the number of interactions would be reduced, only the tier would be left. In contrast, this organisation's renewed powder-coating installation changed from being automated to now being operated manually. The reason given was rather cryptic, indicating a long payback time of automation with customer demand, but as a result of the change, the interaction surrounding the installation increased—'previously it was standing in one place and hanging a plate in the powder coat; simple. Now they are responsible as a team to ensure that steps in the process are done as quickly as possible in succession. That is only possible if they are well attuned to each other' (R10). It goes to show that in times of industry 4.0, improvements are not always smart.

As a power management company, two interviewees highlighted the smart grid, which can be considered a modern electric power grid infrastructure. The new smart grid project is still a struggle, however, since they would like to incorporate smart elements in their products, but what the customers want is still vague to them. In summary, it seems that for this organisation, industry 4.0 has so far mostly resulted in the creation of research projects or a separate department which checks whether there are technologies which they can apply. Consequently, no drastic alterations in the social dimensions of work were found, and the change that was observed surprisingly stemmed from a reduction in technology.

10.5.5 Internal Collaboration—Mass Flow Metre Production Firm

Two developments that stood out in this production case were the introduction of a 3D printer and the new inhouse production of sensors. The 3D printer replaced the procedure of sending designs for tools to Asia, which has led to a quicker and cheaper process. As a result, a tooling engineer signalled the presence of collaboration with the 3D printer operator, R&D and his own colleagues—'I do not print 3D myself, but I try to contribute ideas. We had a glue tooling but during gluing it was in the way of soldering. So I asked, is it possible to turn it around? With a colleague something new was drawn and printed 3D. Then we tested it, we did think it through? You get to a design in a cheap and fairly quick manner, and we get it checked by people in the department. Ask them what they think of it' (R9).

The importance of collaboration with R&D is also visible for the new inhouse production of sensors—'we have a new line, the sensor production. That is all new to us. You come to realise that the ideas they have are not that easy to implement. Single pieces are fine, but if you want more than ten, twenty or thirty products a day then some actions become quite difficult to repeat. In that respect you have to communicate a lot with people who are in production, who have a different view on that. Previously, they thought of something, and we just had to make it' (R8). The difficulty of repeating certain actions likely stems from the fact that sensors have become more complex and contain more electronics. This complexity was also one of the reasons why the organisation decided to bring the sensor production inhouse. A logical consequence of this transition is the dependence created on this department instead of an external supplier that can no longer function as a solid backup—'the process depends on us in principle, because it is our group that makes the sensors. There is another supplier, but they would have to restart again. Then you have a longer delivery time and that supplier cannot weld' (R9).

10.6 Discussion

10.6.1 Interaction Outside the Organisation

The shift in customer contact and the introduction of a lending structure indicate that the engineers in our technical service providers are handling a greater amount of communication with external parties. In addition, the lending structure adds a new party to the standard set of customers and suppliers, while the development in the type of customer that engineers come into contact with (i.e. customer's inhouse programmers) further highlights that there are changes going on with respect to the interactions employees have with people outside the organisation.

Another finding was the lack of such advances within the two production cases. Although engineers address technical issues, the data did not show changes in the role of engineers or of the sales/service department. What was observed (no communication between production and service as well as a clear refusal to share information with competitors) goes against industry 4.0 developments. In the light of the above, we argue that technical service providers will need to pay attention to the social characteristic interaction outside the organisation. Further research is required to investigate whether this dimension remains the same for production organisations, whether it was specific to our two cases, or if we were simply too early to observe any changes in the external interactions for such organisations.

Based on the visible changes within the technical service providers, academics are urged to expand the body of knowledge concerning this dimension since insights into the interaction outside the organisation are currently scarce. The meta-analysis by Humphrey et al. (2007) includes only a single correlation, and articles discussing the future of job design (Oldham & Fried, 2016; Oldham & Hackman, 2010) do not tackle this social characteristic. Stemming from our findings, an interesting research direction would be the inquiry into the types of lending structures that are arising in parallel with industry 4.0 and the consequences of such structures for employees and organisations.

In the introduction, we pointed out that one of the associated expectations of industry 4.0 is the realisation of a far-reaching supply chain cooperation. Our data, however, do not present much evidence for this transition. In addition, a critical element underlying this development (Internet of Things, IOT) hardly showed up in our interviews and when it did, it was in relation to exploration—'what we have done is purely on IOT, we have set up a team that fully focuses on that and initially only pioneers what is out there' (R4). Consequently, the fulfilment of a smart supply chain might, for now, be a bridge too far. We state 'for now' as the example of Bosch (i.e. their obligation to suppliers to place barcodes everywhere) offers a glimpse of what is possible. At the same time, it highlights that when the expectations raised take off, they will create a large digital data flow. Yet the question of to what extent it influences the external interactions remains; will they decrease, increase or be unaffected? Another point of research that the Bosch example suggests is the impact

that the introduction of such a demand creates. In other words, will it strengthen or damage the existing relations and why?

10.6.2 Teams

The technical service providers indicated that in an industry 4.0 context, where technology is becoming more complex and interconnected and broadening, an individualistic approach to work no longer functions. Both organisations therefore transitioned to self-steering, multidisciplinary teams with a scrum approach. One element of this approach concerns the (bi)weekly stand-up meetings in which progress and existing hurdles are addressed. As a result, social support has become easier and faster since respondents mentioned the reduction in travel time between departments and knowing who possesses which specialism. It is expected that the extent of feedback from others also increased as, firstly, the stand-ups cover which points are finished (or not) and, secondly, the team members have become dependent on each other for the survival of the team—'if we do not deliver anything, then the budget will be withdrawn and the team will be dissolved' (R5). In other words, colleagues now have more opportunities and motives to discuss each other's job performance.

With regard to task interdependence, one respondent stated that he is not dependent on others in his work as he mostly works independently. The team approach, however, introduces different types of interdependence. As previously mentioned, they are dependent on each other for the survival of the team and individual tasks at some point have to come together at the team level. Given the fact that the concept of teams is hardly considered a new phenomenon, the above might not offer huge innovative insights for the technical service providers (and other organisations) or academia. Yet based on the findings, we want to emphasise two aspects. Firstly, the multidimensionality of the interdependence dimension does not receive the credit it deserves. The increasing use of a team structure places more emphasis on varieties in interdependence, and academics are aware of these multiple facets (Grant et al., 2011; Parker, Wall, & Cordery, 2001). At the same time, the last job design model makes a distinction in autonomy but only focuses on task interdependence (Morgeson et al., 2013). We therefore want to put renewed attention on the message expressed by Grant et al. (2011, p. 441): 'it is puzzling that other job characteristics have not been seen as multidimensional when related literatures have highlighted multiple facets'. Secondly, one respondent mentioned a social struggle that has arisen as a result of current developments—balancing better information sharing between disciplines on the one hand and maintaining knowledge exchange in the same discipline on the other. Research opportunities are thus reserved for assessing whether this struggle is widely experienced, if the addressed solution can be considered a best practice, or if other methods are adopted.

10.6.3 Physical Assets and Inhouse Production

For both production organisations, the discussions surrounding newly introduced or potential assets stood out with respect to industry 4.0. One organisation shifted to an inhouse production of its sensors, which led to an increase in feedback from others. For example, designs stemming from R&D are not easily produced in bulk. Solving the problem without R&D, as used to be the usual procedure, is apparently not an option here. It resulted in communication, or co-design, between the sensor production and R&D regarding the output of the latter.

The 3D printer introduced by the same organisation resulted in an increase in social support since it offered a cheap and quick manner for designing things. Adjustments are therefore easier to implement, and requesting support from others thus becomes more accessible. A reduction in interdependence was not ensured, however, since employees do not print items themselves, so there was only a shift from an external supplier to the internal 3D printer operator. A similar shift was observed for sensor production. The level of interdependence did change for employees of the renewed powder-coating installation. Finally, the potential application of light or other signals as a means of work instructions is expected to drastically alter social interactions. It would likely simplify tasks to such an extent that most types of interactions will become superfluous, hence the comment, 'only the tier will be left' (R11). Production organisations are therefore alerted to keep social influences in mind when introducing such developments. In other words, a reduction in social interactions could be a welcoming solution for certain people (e.g. those with a distance to the labour market), but they also need to be the target group.

The decrease in technology observed in one of our cases also creates future research opportunities. A question that could be asked is if it represents the presence of a counter-movement, or whether the viewpoint of this organisation should be considered an exception that will cause problems in the long term? (e.g. 'we have many manual activities. That has to do with the numbers and the customer-specific parts. That is why we are still here for if everything is completely automated, you can go to, for example, Romania, because then it will cost nothing'; R10).

10.6.4 From Social to Digital?

The Internet, email, WhatsApp groups, video meetings, SharePoint and software applications such as Apex are a few of the digital tools that were mentioned during interviews with both types of organisations. This highlights the embeddedness of a digital way of interacting in our current way of working. Yet none of the examples are communication methods based on the far-reaching digitalisation that underlies terms like big data, Internet of Things and augmented reality; hence, they do not reflect industry 4.0. Consequently, we could raise the point that we were simply too early to detect a growing digital invasion. However, the acknowledgement of stand-

up, sprint or tier meetings, travelling between locations (in one case, collaboration needs to take place between two different locations which is facilitated by means of a video connection, yet it was stressed that being able to see, smell and feel each other works the best) as well as a supervisor's indication of wanting daily contact with his employees stresses that digital contact has not, and will likely never, fully take over. In other words, social and digital means of contact are expected to coexist since they seem to be used for different reasons. For instance, quick solutions or minimising the interruption of flow versus discussions, not alienate from each other or a lack of digital options. We assume that this dichotomy will persist in an industry 4.0 context. Additional support for the preservation of social contact can be found in the following quote: 'with the what, data often does not lie. But you also have a how. How do people do that? How are people doing? Then you come more towards the soft side. Passion is sometimes very difficult to make smart' (R10).

10.7 Insights and Synopsis

Industry 4.0 is represented by means of the three technology-based developmental streams that currently exist: *connected,* establishment of connections between devices and/or systems within firms and with external parties; *informed*, ability to take greater advantage of the value of information; and *equipped,* availability of contemporary (non)physical assets (Habraken & Bondarouk, forthcoming). The respondents' acknowledgement of the complexity of technology and the observed presence of an exploration stage regarding the first two streams highlighted that the adoption of these streams is not that straightforward. Nonetheless, the perceived complexity has already led to the following findings:

- Extent of interaction with customers increased for the technical service providers. Not only are their engineers more in contact with the customers, the type of customers they deal with has also expanded. It raises the need for organisations to pay attention to, and for academia to conduct more research into the effects of the characteristic interactions outside the organisation.
- A new external party was observed—a hired knowledge expert stemming from the lending structure. This also creates an additional source of social support for the technical service providers. Apart from gaining assistance or advice from supervisors or co-workers, external sources such as competitors are contacted for help. Given its newness, this lending structure creates interesting research possibilities which could also assist practice with identified challenges related to this structure.
- Both technical service providers transitioned to operating in self-steering, multidisciplinary teams. This transition subsequently led to an increase in social support, and we also expect a growth in the extent of feedback from others given increased team dependency and the stand-up meetings. Though teams are a known structure,

findings raise the issue of multidimensionality of characteristics and an apparent struggle when it comes to team formation.
- A transition to inhouse production of sensors was observed in one of the production organisations, which led to an increase in feedback from others and a shift in the source of interdependence.

Changes to the social work context were also found as a result of the presence of physical assets. The 3D printer within one production organisation resulted in an increase in social support and a shift in the source of interdependence, while the idea of using lights or other signals as work instructions by the other production organisation was expected to reduce the extent of social interaction in general. The direction of intensity change thus varies per technology and means of adoption. Organisations are therefore advised to take the social aspects into consideration during the decision process.

The above insights are represented in Fig. 10.2. It depicts industry 4.0 with the observed abstract terms and the three technology-based developmental streams that underlie them. Each specific stream is represented by more or less spikes depending on the observed implementation level. Industry 4.0, in turn, was found to influence the social context of work in two ways: (1) by altering the intensity or source of current social work characteristics and (2) by introducing new or emphasising known structures. Finally, the vertical arrow indicates that the bottom structures can cause changes to the intensity level.

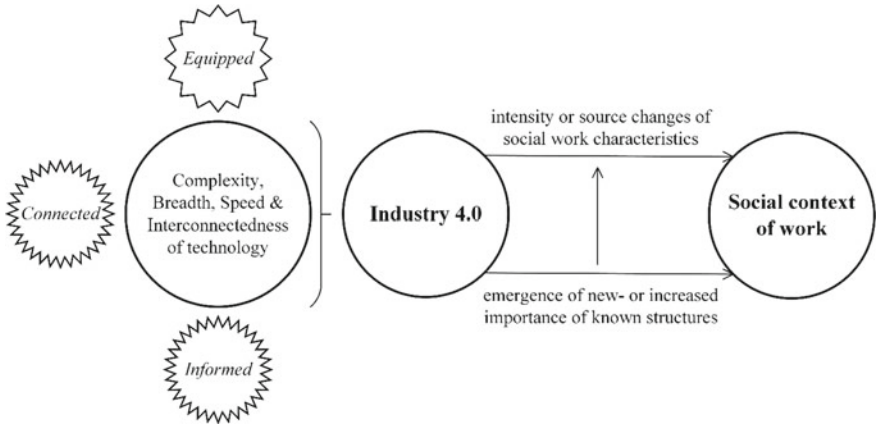

Fig. 10.2 Summary of the chapter. Based on interview data

10.8 Limitations

Given the aim of our study, we have to point out that despite our careful selection, industry 4.0 still seems to be more a subject of research than reality. This finding fits our opinion that industry 4.0 is not the rapid major change that the definition of industrial revolution defines it to be (Habraken & Bondarouk, forthcoming). Yet, it poses a limitation to the current study. Another limitation is the specific focus on the manufacturing industry since industry 4.0 is also applicable to sectors such as healthcare or transport. We expect that the presence of alterations in the intensity of current social work characteristics is applicable to other sectors. For instance, with the introduction of patient coaching platforms, an increase in interaction between physicians, nurses and patients could be assumed.

10.9 Conclusion

In sum, three developments concerning the link between industry 4.0 and the social context of work can be found as well as one general remark. Beginning with the latter, the low presence of industry 4.0 in the selected cases should in our view be classified as a valuable finding as well as a limitation. It stresses that more attention needs to go to the implementation of industry 4.0. Turning to the three developments, we firstly expect that social and digital means of interaction will coexist in an industry 4.0 context. The second and third developments highlight two ways in which industry 4.0 was found to influence the social context of work: altering the intensity/source of current social work characteristics *and* introducing new/emphasising known structures.

Appendix—Interview Protocol

Name of interviewee:	Date:
Location:	Function:
Start time of interview:	End time of interview:
Specifics:	

Introduction

Aim: *get to know interviewee, introduce purpose of the interview and mention their rights*

Address:
- Introduction of interviewer
- Research set-up
- Rights of interviewee
- Informed consent
- Introduction of interviewee (function, work experiences, work activities)

Topic X – 1. Feedback from others; 2. Social support; 3. Interaction outside the organisation and 4. Interdependence

Aim: *to gain insights into the experience of characteristic X at the moment and to reflect on the changes in relation to the past, specifically the influence of technology. A standard question for each subject is: "how does this happen?" and / or "what does this look like?"*

Questions:
- How has X changed in the past 5 years? [explain the respective characteristic when necessary]
- In what way has technology played a role in this change?
  - When mentioning smart industry (SI) > inquire about the different technologies and dive into specifics regarding changes of the characteristic and respective SI technologies
  - When SI is not mentioned > search for the cause of change and link to SI when possible

NOTE: when interviewee was an employee, questions adopted the standpoint of their own work. When interviewee was a manager, questions adopted a 'group perspective' (i.e. the department they managed).

Closing

Address possibility for respondent to reflect/offer feedback on their answers

Thank you

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