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Source: *Work Organisation, Labour & Globalisation*, 2023, Vol. 17, No. 1 (2023), pp. 136-152

Published by: Pluto Journals

Stable URL: https://www.jstor.org/stable/10.2307/48724545

In control or out of control?

Worker perceptions of autonomy and control using self-reliant digital systems at airports

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ABSTRACT

Self-reliant digital systems (SDS) can adapt to changing circumstances and environments, evaluate complex situations, make decisions and optimise processes. In this context, work processes also change, since SDS are controlled by workers but are also partly out of control, that is, processing information independently and without worker influence. It can be expected that handling and interacting with SDS impact workers' perception of autonomy and control and their interrelationship. This paper focuses on these developments at airports and is based on 24 interviews with airport and flight staff. The findings point to a difference between objective control and the perception of control. Moreover, we identify autonomy-enhancing and autonomy-restricting forms of control in contexts using SDS. In this sense, the article contributes to clarifying autonomy and control in the specific context of SDS at airports and conceptualising the interrelation of autonomy and control.

DOI:10.13169/workorgalaboglob.17.1.0136

KEY WORDS
autonomy, control, digitalisation, self-reliance, self-reliant digital systems (SDS)

Introduction

The implementation and use of digital technologies is creating new tasks in work contexts. As artificial intelligence (AI) and other applications are applied, for example in machine learning but also speech and image processing, there is an increasing need for digital self-reliance with regard to communication, decision preparation and – where appropriate – decision-making processes by machines and digital entities (Jakesch et al., 2019; Meijerink & Bondarouk, 2023; Schneider, Nebel, Beege, & Rey, 2018; Zhang et al., 2021). In this sense, the self-reliance of digital systems leads to new technical, organisational, social and legal questions and profoundly changes the working environment. Since the interaction and tasks of workers also create altered possibilities of control (Malsch & Schulz-Schaeffer, 2007; Pfeiffer, 2018), it is empirically unclear how control options are perceived by the users and how the worker's perception of autonomy is influenced by this. In any case, the worker's perception of autonomy and control has a critical impact on work behaviour and performance (Strunk, Faltermaier, Ihl, & Fiedler, 2021). This article is dedicated to the question of how self-reliant digital systems (SDS) affect the interrelation of worker autonomy and control perception.

Digitalisation is a broad and dynamic field of research. Orlikowski (2016) states that work is nearly always connected to the digital. The term digitalisation is frequently used but rarely defined specifically. The definition of *digitisation* as the conversion of analogue signals (data) into (binary) values is technical in nature. Our understanding considers the human worker (the workforce) and posits that *digitalisation* encompasses the sociotechnical process of applying technologies to social and institutional contexts profoundly changing work environments (Tilson, Lyytinen & Sørensen, 2010; Wilkesmann & Wilkesmann, 2018). Digital technologies can be implemented to support decision-making processes at work. The use of digital technologies can lead to other automation and self-reliance processes. For example, the work of robots can be a substitute for activities previously performed by humans (Decker, Fischer & Ott, 2017).

SDS are digital technologies that can adapt to changing circumstances and environments, assess complex situations, support decision-making processes, make decisions and optimise their behaviour based on data or experience (Kündig & Bütschi, 2008). In this context, Schulz-Schaeffer (2008) differentiates stages of self-reliance – from the compulsory completion of predetermined work steps to learning systems – and introduces the degree of disposal of resources as a further aspect of independence. SDS act with increasing autonomy, whether as stand-alone devices or in combination with other 'intelligent' devices and information sources. Moreover, Schulz-Schaeffer (2008) differentiates between information- and rule-generating processes. Information-generating SDS generate new information from available data; rule-generation implies decisions and behaviour rules resulting from available data and guiding autonomous decisions between alternatives. In either case, SDS imply different

levels of cooperation with humans, leading to an altered distribution of competencies between humans and technologies within work contexts (Schulz-Schaeffer, 2019).

Interaction with SDS is likely to affect workers' perception of autonomy as well as their perception of control. Unwanted control and technological decision-making could potentially be perceived as incapacitation. At the same time, control elements can be seen as supporting error prevention. In this sense, the use of SDS may support safety (Agarwal, Gao, DesRoches & Jha, 2010), as they promote an increase of data relevant to work processes and help to monitor individual performance and thus detect errors. However, the use of SDS can also contribute to increased uncertainty, for example, when actions require the congruent interpretation of data by multiple actors.

Our analysis of workers' perception of autonomy and control in using SDS is based on 24 interviews with airport and flight staff. The paper contributes firstly to clarifying the role of autonomy and control in the specific context of SDS and secondly to conceptualising the interrelationship between autonomy and control in digital work contexts.

The remainder of this article is organised as follows: after the introduction, we present our conceptual framework referring to SDS and human-technology interaction and the interrelationship of autonomy and control. The next section provides a description of the methods used and an introduction to airports as examples of the use of SDS in relation to the implications for the interrelationship between autonomy and control in this context. The empirical findings are also described in this section. Then, we continue with the discussion summarising the findings, reflecting on the conceptual contributions as well as the limitations and avenues for future research. The article ends with a conclusion.

Conceptual framework

SDS and human-technology interaction

The use of digital technologies and SDS requires interaction between humans and technologies. Technologies are usually intended to support humans while they are able to control technologies. SDS can, for example, provide suggestions and instructions about how to work, sort and interpret data and information and act as automated (warning) systems. However, the human–technology interaction (HTI) is particularly prone to error since these interactions can lead to misunderstandings, interpretation difficulties and errors. This may seem contradictory since most SDS are designed to support humans and eliminate possible sources of human error. Nevertheless, it is apparent that notable precursors of accidents are conflicts between humans and technologies, caused by insufficient automation (Pizziol, Tessier & Dehais, 2014). This can be explained by the fact that several agents (for example, humans and technologies) share common tasks or resources. In this process, humans and technologies might have the same aim, but they have different logics and knowledge to make decisions and perform. Consequently, difficulties arise, and conflicts are likely to occur (Pizziol et al., 2014; Weyer, 2006). It is important that workers have the autonomy to make decisions about technology use. Even if SDS are used for decision support, human confirmation

is usually still required. HTI with SDS requires control and monitoring functions, and thus, depending on the degree of intervention and control, also influences workers' perceptions of autonomy and whether they perceive SDS as being in control or out of control.

Interrelation of autonomy and control perception

The use of SDS offers advantages to workers, such as increased autonomy due to automated processes and decisions, as workers may concentrate on other tasks, for example, supervisory and strategic, ones (Gregg, 2011). At the same time, workers need to control and are subject to control within the work processes of SDS (Ball, 2010; Kallinikos, 2011). The occurrence of autonomy and control issues is assumed to increase in intensity and importance in digital work contexts (Mazmanian, Orlikowski & Yates, 2013; Orlikowski, 2016; Scott & Orlikowski, 2008). The interrelation of autonomy and control is addressed in the so-called autonomy-control paradox (Bader & Kaiser, 2017; Mazmanian et al., 2013; Stohl, Stohl & Leonardi, 2016).

Autonomy is understood as 'the degree to which the job provides substantial freedom, independence and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out' (Hackman & Oldham, 1975:162). Autonomy in the workplace, however, should be seen as freedom in terms of not only work planning and work procedures but also work criteria, performance standards and goals. Autonomy also means that individuals have objective control over the task process and task performance (Breaugh, 1985; Evans & Fischer, 1992).

Child (2015:144) states that 'control may be defined as a process whereby management or other groups are able to initiate and regulate the conduct of activities such that their results accord with the goals and expectations held by those groups'. There are different modes of control (Ruiner & Klumpp, 2022): for example, digitalisation complements organisational or managerial control (Hall, 2010; Moore, Upchurch & Whittaker, 2018) with control by individuals themselves (self-control), their colleagues (peer control) (Ezzamel & Willmott, 1998; Sewell, 1998), customers (customer control) (Wood, Graham, Lehdonvirta & Hjorth, 2018) and the underlying algorithm (algorithmic control) (Lee, Kusbit, Metsky & Dabbish, 2015; Möhlmann & Zalmanson, 2017). In the context of SDS, algorithmic control seems particularly relevant. This mode of control combines algorithmic work assignment, information support and data-driven evaluation of performance (Lee et al., 2015). Algorithmic control 'is characterised by continuously tracking and evaluating worker behaviour and performance, as well as automatic implementation of algorithmic decisions' (Möhlmann & Zalmanson, 2017: 4). In this sense, the use of SDS is changing control in organisations (Hall, 2010; Moore et al., 2018) and the self-control mechanisms involved are reinforced by digitalisation, which enables the transparency of individual performance and leads to workers' self-control while experiencing autonomy. Evans and Fischer (1992) have already established a link between job autonomy and perceived control, indicating that job autonomy is influenced by the general perception of control in the workplace. The interrelationship between autonomy and control perception at work is especially affected in using SDS and is the focus of this article.

Methods

Empirical context

To analyse how SDS as examples of the digital transformation affect the interrelationship between worker autonomy and control perception, we refer to empirical fieldwork. This is relevant as the specific acceptance of SDS in operational work contexts like the working environment of pilots or flight crews is determining the impact of SDS and the digital transformation in general. Here, SDS represents the development of independent machine decision-making capabilities. In the case of autopilot systems, the influence on human work is obvious, for example, as pilots will have to work shorter times during a flight, even enabling concepts like the single pilot cockpit. On the other hand, new stress factors might also arise in the increasing complexity regarding supervising SDS, with their increased range of analysis and decision-making capabilities.

In this article, we concentrate on airports since the use of SDS is already well established and observable in this context – especially in the aircraft itself (Sanjog et al., 2015; Zaharia & Pietreanu, 2018) providing interesting insights. For the air transport sector, SDS, such as autopilot steering or digital process support in administration and customer service, have a long history (Chengqi, Cen & Yan, 2009; Kovynyov & Mikut, 2019). Moreover, since airplane hijackings were identified as a threat to system reliability, commercial airlines have invested in passenger and baggage screening (Duchesneau & Langlois, 2017; Steno et al., 2021). The use of SDS in air passenger and baggage security is especially interesting because, in addition to increasingly automated passenger and baggage screening technologies, certain key decision elements are judgmental and yet lack precise decision rules. Additionally, SDS are used to support workers in their work during inspection and maintenance. Many supporting technologies are implemented in the cockpit, such as the autopilot (Casner & Schooler, 2014) and head-up displays for pilots, which provide information about the terrain around the airplane as well as relevant information during the flight (Kim & Kaber, 2014). Furthermore, the use of electronic flight bags in the cockpit is an example of SDS for flight management and information administration. SDS simplify workflows for pilots in the cockpit and for flight crew (Carroll & Dahlstrom, 2021).

So far, digital work processes have been extensively analysed for air traffic controllers (Li, Kearney, Braithwaite & Lincet, 2018; Miramontes et al., 2015; Strybel et al., 2016) whereas other professional groups, such as security staff, have received only little attention (Chavaillaz, Schwaninger Michel, & Sauer, 2019). Today, customer integration is of high importance and shapes the competitiveness of airports and airlines (Milne, Delcea, Cotfas, & Salaricet, 2019; Negri, Borille, & Falcao, 2019). Current research addresses the question of worker reaction for pilots, ground staff and service staff, limiting how far and fast SDS might proceed in airport hubs (Cvetnic, 2008; Jungmann, Bierbichler, Peuker & Voss, 2016; Liu et al., 2018; Matuschek, 2008; Matuschek & Voss, 2008; Zaharia & Pietreanu, 2018). Although airports are highly specific, they exemplify the high level of safety and security that is required when many people are involved. The results regarding the perception of autonomy and control under the influence of SDS can therefore also be relevant in other organisations besides airports and the air

transportation sector, for example, within security organisations, the health care sector or critical infrastructure organisations such as in the energy sector. It remains to be demonstrated empirically to what extent the results presented here have the potential to be transferred to other contexts, as the provided examples show vividly.

Empirical approach

Our empirical research drew on expert interviews (Döringer, 2021) with representatives of organisations (at the strategic organisational level and operational level of workers) and guideline-based, problem-centred interviews (Witzel, 2000) with professional groups in airports. The analysis in this article is based on 24 interviews with airport staff, including executives, pilots, flight attendants (as crew members), security and ground staff, recruited from different airports in Germany. Table 1 summarises the characteristics of the interviewees.

Table 1: Interview sample characteristics

	Gender	Year of birth	Average work experience (years)	Interview duration (minutes)
Executive 1	M	1987	2	95
Executive 2	M	1972	3,5	33
Flight attendant 1	F	1996	2	64
Flight attendant 2	F	1986	12	59
Flight attendant 3	F	1977	14	91
Flight attendant 4	M	1990	4	87
Flight attendant 5	F	1971	26	63
Flight attendant 6	F	2001	3	41
Flight attendant 7	F	2000	4	42
Flight attendant 8	F	2001	3	32
Flight attendant 9	F	1961	39	52
Flight attendant 10	F	1980	21	60
Ground staff 1	M	1978	20	55
Pilot 1	M	1980	8	87
Pilot 2	M	1988	8	55
Pilot 3	M	1968	29	78
Pilot 4	M	1981	17	62
Pilot 5	M	1974	22	89
Pilot 6	F	1980	4	108
Security staff 1	F	1985	4	111
Security staff 2	F	1974	14	48
Security staff 3	M	1970	21	43
Security staff 4	F	1979	1	35
Security staff 5	M	1967	16	51

Two semi-structured interview guidelines for experts and professional groups were developed for the interviews. Both guidelines include six thematic sections in which the interview questions were structured. The thematic sections dealt with the current professional position, the work tasks and the individual's own self-image, as well as the effects of digitalisation in daily working life. The next group of questions addressed the use of technology and the resulting changes in the workplace and the perception of autonomy and control, as well as trust in technologies. Further questions were asked about teamwork, communication structures in the workplace and the division of work tasks as well as team structures and how they changed in emergency situations. Critical events were also examined in more detail. Finally, the last thematic section dealt with the potential of the use of digital technologies.

The results were analysed based on qualitative content analysis (Mayring, 2000). This type of analysis is used to define evaluation aspects and rules in order to enable a systematic, intersubjectively verifiable means of working through large amounts of text while, at the same time, allowing specific passages of text to be interpreted in a more profound, open and not category-guided hermeneutic way. To interpret the qualitative interviews in detail and gain deeper access to the 'true meaning' (Wernet, 2013) of the statements, partial hermeneutic procedures were used (Oevermann, Allert, Konau & Krambeck, 1979) in order to investigate the perceptions of the interviewees.

Empirical findings

Control reinforcing autonomy

In the empirical findings section, we will first refer to autonomy reinforcing or being restricted by control. We then point to the perception of control and legitimising restrictive control. The empirical results show that workers perceive autonomy when there is a possibility of intervening in SDS. This scope of action means that control remains with the employees.

> *But in this respect, you have autonomy over everything. So, you can always switch off the autopilot in case of doubt. That's a push of a button. And then you have the airplane in your hands and you control it manually.* (Pilot 3: 56)

Nevertheless, the presence of SDS favours the reduction of autonomy. More concretely, the use of SDS reduces perceived autonomy and the perception of autonomy is higher in contexts with less SDS. At this point, different origins of the perception of autonomy within the professional groups and their degree of SDS use become apparent. The professional group of pilots is confronted with high use of SDS and at times perceives this as a restriction of autonomy if the corresponding legitimations are not available. In contrast, such a restriction is not observed in the area of ground staff, as the use of SDS is very limited here.

> *In fact, digitalisation is actually a catalyst in a story like this, that you actually have to carry out more and more procedures that you have been given by others. And I think it's fair to say that autonomy tends to decrease as a result.* (Pilot 1: 29)

> *So basically, I can act totally autonomously. Everything I do, there is no computer or program that tells me what to do or anything like that. And I don't think that's going to happen here either, because it simply can't be automated.* (Ground staff 1: 47)

The use of SDS is perceived by the workers as influencing work processes so far as the control of SDS becomes the ostensible work activity of the workers. However, if a possibility to intervene exists, this is partly also perceived as autonomy, as the following quote emphasises:

> *So, we do less and scan more, so we monitor more. … So, I start the airplane once, I push the nose up and turn on the autopilot and then I turn it off again three hundred feet off the ground and land the airplane. And then we actually sit back and just watch. We're just scanning. So, we're looking to see if the airplane is doing everything right.* (Pilot 6: 53)

In addition, control is also described, especially by pilots, as one interviewee illustrates:

> *Big Brother is watching. If I make an approach somewhere that is completely outside our rules, where I say no, I'm the boss here, I'm going to do what I want and that's not the way we're supposed to do it, then that's being watched.* (Pilot 3: 62)

The perception of control has an influence on work behaviour. For example, even minor errors are reported because it is clear that concealment can be uncovered at any time due to the high transparency of work processes and performance. In this context, it is striking that if the restriction is sensed as legitimate (for example, by process transparency or safety relevance), the limitation of autonomy is perceived as small.

> *So of course, I can work autonomously myself, but there are limits, that's simply marked out. There is a defined field of activity in which I can act. And that's also very narrow for security reasons, so of course it makes sense that the individual isn't granted a great deal of autonomy.* (Flight attendant 4: 85)

> *So, when we start work, I also have to take off my things. And I also have to be checked again, depending on the person. … but then I also have to go through the security area. I am checked by trained personnel, who also check themselves, so I am also checked again thoroughly by the organisation, with the same guidelines as we do.* (Security staff 1: 103)

> *… because of course the IT constantly monitors our computers a bit, you get an email every now and then saying that the new OS hasn't been installed yet, you have to install it by the end of next week. And then you think, how do they know that and then you realise, yes, of course they monitor all the devices from a distance all the time and always check whether they are up to date. But I'm actually completely autonomous when it comes to working, so I don't have any restrictions or anything. No.* (Pilot 4: 47)

If control takes place in a form in which it preserves the privacy of the workers, they also perceive the control as legitimate and do not feel restricted by it.

If you ask about my personal perception, I think to myself, yes, that should happen. But I personally don't feel controlled, because I am a small data point in millions of data points. In this respect, it is actually something that happens. That I am controlled at this point, but anonymised. (Pilot 1: 31)

… But I wouldn't say that they are somehow invading my privacy, because the device is switched off when I'm not working and when I'm on business, I'm on business and I'm not aware of that. They don't watch you or anything. But otherwise, you're not really so restricted or so that you somehow feel controlled. (Flight attendant 2: 55)

Control restricting autonomy

If the corresponding control is not perceived as legitimate (for example, transparency of processes), it leads to the perception that control is not legitimate and the technology used is not understood nor accepted or used. This can influence the use of the technology and thus the decision-making and actions of the workers and lead to SDS being perceived as out of control.

Processes are increasingly automated, without there being A) particularly many opportunities for external influence by any employees, B) that employees are available at all to monitor these systems. And C) that the acceptance of the crews for such a system is not necessarily there, because it is simply not obvious how this decision is made. (Pilot 2: 73)

Even if I do it more or less by myself, my tasks are … throughout, everything is always very strongly regulated. So, I actually perceive autonomy. No, not much. (Flight attendant 3: 157)

That's not autonomous. Like this. There is the dispatcher, he also sits at the screen and always has these time bars in view and then the colour changes when they press something. And then he sees where the people are at the moment. And when the order turns grey, he throws the next one on top of it. And of course, he looks at the position he's in so that he doesn't have to travel so far to get to the next plane. And then he is, shall I say, actively planned, isn't he? So it's not autonomous, like that. With the maintenance shop, it's actually different. There they are really more autonomous. Because there … I don't have a real-time scheduling tool with the scheduling of these maintenance orders. I can only assign work orders, but which ones he actually picks up now, which ones he pulls out now, I have to ask, so to speak. And if I didn't do that, he could do what he wants. There he would be autonomous. But he's not supposed to be, really. (Executive 1: 197)

Everything is prescribed. And accordingly, you can't say, OK, I'll do it myself or something. (Security staff 1: 95)

It becomes apparent that even in the case of objective control, control is not perceived as such if it is legitimised. If control is perceived as illegitimate, autonomy is perceived as limited and there is the possibility of a perception of uncontrollability. Then, SDS are out of control, as workers cannot actively influence the processes.

Discussion and contribution

Summary of findings

This article aimed to analyse how SDS affect the interrelationship of worker autonomy and control perception by focusing on staff at airports. Based on the interviews analysed and with regard to the different professional groups that were investigated, it is striking that there is a stronger perception of reduced autonomy when SDS are used (for example, in cockpits) than when no SDS are used (for example, ground staff). In cockpits, however, objective control is also perceived as non-restricting autonomy and as legitimate (for example for safety reasons). In this sense, SDS permeate the work settings focused. Perceptions of autonomy and control and their interrelationship are relevant to the worker's work behaviour and are affected by the use of SDS. A key point here is that objective control differs from perceived (subjective) control, as long as the worker can intervene, for example, with a kill switch or other measures for SDS. Therefore, the control that reinforces the perception of autonomy is a different form of self-control. This is to be conceptually distinguished from traditional self-control, in which the individual controls himself and his own actions. The interrelationship of autonomy and control is thus presented in such a way that objective control is recognised from the outside and restricts autonomy and control that strengthens autonomy. However, this objective restriction can be subjectively perceived as non-restrictive through the legitimisation of control.

Regarding the different professional groups, it can be stated that the respective organisational framework on which the implementation of SDS is based appears to be central. Pilots emphasise the possibility of intervening in the systems, while flight attendants perceive their autonomy in the fact that their tasks cannot be taken over by SDS to a large extent. Safety reasons have a dual role in that they legitimise control across occupational groups. One difference lies in the justification space, which is related to the specific task area. Pilots assume the supervision of every intervention and decision. There is therefore a direct task reference here. Flight attendants and security staff, on the other hand, refer to standardised environmental factors (for example, passing through security control as airport staff). The degree of interaction with SDS thus appears to be central. Professional groups also differ in their perspective on SDS and on control. Pilots and executives tend to emphasise a process perspective. This includes participation in the decision-making process of implementing SDS and interfaces with other airport actors. Flight attendants, on the other hand, refer to regulation in their own area of responsibility. In this context, external regulation is consequently seen from different organisational embeddings and argued as restricting autonomy.

SDS and the associated possibilities of control are initially unknown to the worker and established interaction patterns must be reinterpreted in some cases (for example, in reporting errors). In this context, the relevance of the HTI is increasing, having an impact on work behaviour insofar as the workers concerned must interpret the suggestions generated to be able to make decisions. In this sense, the perception of autonomy and control in the use of SDS is based on the worker's interpretation and is especially relevant when stringent attention and situational awareness are required. In

this context, the interrelationship between autonomy and control in the use of SDS appears relevant for workers' behaviours and performance.

Concerning the research question, it can be stated that autonomy is not perceived as restricted if workers have the feeling that they can intervene in the SDS and stay in control or if there is a valid reason for the objective restriction (for example, safety relevance or process transparency). At the same time, if there is control that is not perceived as legitimate, autonomy is perceived as limited and thus control is perceived as restrictive. In this sense, we found autonomy-enhancing control and autonomy-restricting control in all the observed occupational fields, particularly in occupational groups where technology is used to support training and to process checklists (for example, flight attendants) control is carried out via digital devices, legitimised by transparency of processes and specifically by guaranteeing security. The legitimisation of control also becomes visible in occupational fields with strongly prescribed processes such as those of flight attendants and security staff. Pilots also legitimise such control by guaranteeing safety and privacy. At the same time, they also actively perceive autonomy when there is the possibility to intervene in the SDS decisions or to switch off the SDS and 'take the helm' on their own. In summary, the interrelation between autonomy and control influenced by SDS in the perception of the individual is highly dependent on legitimising control and, therefore, reinforces the perception of autonomy.

Conceptual and empirical contributions

The use of SDS in organisational contexts has major impacts on work processes having the potential both for bringing improvements and for introducing hazards, depending on the worker's behaviour. This is especially critical with regard to organisations such as airports, where safety and security issues are of central relevance. There are different levels of autonomy of SDS (Schulz-Schaeffer 2008) – from the obligatory execution of prescribed work steps to learning systems, all of which influence cooperation in the professional fields. The degree of availability of resources constitutes another aspect of autonomy. Information-generating SDS (which generate new information from available data) can be observed, for example, in the field of flight attendants. Rule-generating SDS (which imply decisions and rules of behaviour that result from the available data and derive autonomous decisions between alternatives) can be found, for example, in the field of pilots. In these contexts, SDS can enhance safety but there is also potential for less safety, pointing to the importance of the workers' perceptions of autonomy and control and how these influence their work behaviour. This can be illustrated by the example of processes in the cockpit of an airplane, because when using digital control and regulation mechanisms (for example, autopilot), human actors intensively defend their interpretive sovereignty and insist on the continuation of independent control of the airplane, even if it would supposedly be easier and possibly safer to apply the SDS (Lee, Kim & Sim, 2019). Against this background, this article contributes firstly, to clarifying the role of autonomy and control in relation to SDS and secondly, to conceptualising the interrelation of autonomy and control.

First, regarding the role of autonomy and control in relation to SDS, it became clear that the autonomy dimensions depend on the concrete HTI between humans and technologies, that is, how workers and SDS are expected to interact and collaborate in

work processes. Thus, the HTI is of great importance and with it the use of SDS to adapt to changing circumstances and environments, assess complex situations, make decisions and optimise behaviours (Flentge, Weber, Behring, & Ziegert, 2008; Kündig & Bütschi, 2008). This has the potential to directly affect the perception of autonomy and control when SDS guides or takes on the decisions of human actors (Bisht, Trusson, Siwale & Ravishankar, 2021). Depending on the form of SDS, workers can experience objective autonomy regarding work planning, processes, standards and goals. Whether they also perceive autonomy is to be differentiated. Thus, we distinguish between objective and subjective measures. This is in line with Spector (1986) who focuses on perceived control rather than objective control, emphasising that this is critical to work outcomes. Regarding control, the same relation can be observed. There could be objective control that is not perceived as such. Moreover, in the previous literature, certain modes of control have been differentiated (Ruiner & Klumpp, 2022). In the context of SDS, algorithmic control (Lee et al., 2015; Möhlmann & Zalmanson, 2017) seems most relevant. However, the term is misleading since not all SDS are based on algorithms. Moreover, we found that in the specific context of airports, institutional or system control through professional contexts is also relevant. Using SDS for information generation could support the availability of new information and rule generation would mean that SDS make decisions and suggestions regarding behaviours resulting from available data (Pacaux-Lemoine et al., 2021; Schulz-Schaeffer, 2008). Self-control is relevant, especially regarding the use of SDS, since these systems might support personal assessments and set the basis for improvements. These two modes of control have not yet been discussed or differentiated in digital work contexts, but they are especially relevant in professional contexts.

Second, in the literature on the autonomy-control paradox (Bader & Kaiser, 2017; Mazmanian et al., 2013; Stohl et al., 2016), it is discussed that the use of SDS enables autonomy (Symon & Pritchard, 2015) and allows workers to be monitored and controlled (Arnold, 2003; Fairweather, 1999). Interestingly, autonomy and control can occur simultaneously (Ruiner & Klumpp, 2022). Consequently, autonomy and control are not mutually exclusive. This refers to the critical relevance of the worker's perception, which is ambivalent with regard to autonomy and control in particular in work contexts with SDS. On the one hand, control is perceived as strengthening autonomy if there is a possibility for workers to intervene or if control is legitimised. Likewise, however, control can be perceived as restricting autonomy if there is no possibility of controlling the influence of the workers or if control has not been legitimised. This depends on the (un) desirability of control: the use of SDS could either be unwanted or seen as supportive. Consequently, sensemaking processes (Adobor, 2005; Weick, 1993; Weick, 2006) are key to understanding the perception of autonomy and control in situations with SDS use, whether workers reconstruct an autonomous or a control-based interaction.

In the airport setting empirically considered, this is particularly relevant for the interrelation of autonomous decisions by SDS and safety. If safety is a rationale for control, it may even be perceived as supportive and thus legitimised rather than perceived as limiting autonomy. However, less transparent processes are met with a lack of understanding on the part of workers and can lead to limited SDS use. In this sense, SDS can be perceived as control and support at the same time. This is in line with

Sewell and Barker (2006) and (Ruiner & Klumpp, 2022), who conceptualised control as coercion or support.

Limitations and further research

This paper has specific limitations. It is based on a qualitative study of 24 workers in the airport context using SDS. The findings are therefore related to a highly specific sample and a particular organisational context. Future research could generalise the findings on the basis of a quantitative-empirical survey that includes other fields and organisational structures. These investigations are particularly relevant in the context of potential interdependencies and interrelationships between the organisational context and perceptions of SDS. Furthermore, sensemaking processes take place in these settings and focusing on these could help to understand the legitimisation of control. Addressing these aspects was not attempted in this analysis and can be developed in further research. An extended analytical approach with a focus on the requirements for investigating the multidimensionality of SDS in an organisational context is warranted. Finally, as participation in the introduction process of SDS plays a decisive role in their adaptation, future research should consider the implementation process of SDS and investigate the effects of the use of SDS.

Conclusion

We have analysed the interrelationship of autonomy and control with regard to the perception of workers using SDS. We found that control either limits autonomy (control by the system) or strengthens it (control by the workers). This perception is also strongly dependent on legitimisation of control. We illustrated this by analysing staff at airports – thereby also showing the different perspectives and settings for different professional groups in a similar organisational context. Further research is warranted and could outline and evaluate especially the transfer potential of these findings into other organisations. Altogether, the emergence and implementation of an increasing number of SDS with enlarged application areas and potentials is an important field for research and for practical work process design within the analysis and management of work systems in societies of the future.

ACKNOWLEDGEMENTS

The authors would like to cordially acknowledge the support and constructive feedback by the editor, guest editors, reviewers and the journal team. Within our institutions, we want to extend our gratitude for back-office support in interview implementation and coding towards Josephine Thums, Sarah Körbel and Anna Gulde. In addition, the author team is grateful for the financial support granted by the German Research Fund (DFG) under the SPP 2267 scheme, grant number 670531.

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