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The enabling and constraining connections between trust and digitalisation in incumbent value chains

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ABSTRACT

Digitalisation is a disruptive socio-technical process that goes beyond digital technologies and their use within an organisation, and involves besides (in many cases radical) technological change, social, institutional and economic change. This creates uncertainties for value chain actors and the trust relationships between them. In this paper we aim to understand the connections between trust and digitalisation. We investigate how trust relations affect digitalisation, and how digitalisation affects trust relations among value chain actors, using the Dutch flower sector as a case study. Our findings show that the sector has a high level of interpersonal trust, but limited institutional trust, as the relationships between companies are highly competitive and transactional. In this context, limited trust hinders digitalisation in multiple and mutually reinforcing ways, inducing a vicious cycle whereby existing distrust or limited trust results in limited digitalisation, which in turn causes more distrust due to uncertainties around the digitalisation process, further increased by existing (technological) path dependencies. Hence there is a need for 1) awareness of mutually reinforcing (dis)trust dynamics and vicious (or virtuous) cycles in relation to digitalisation are needed; 2) higher levels of understanding of what digitalisation entails and 3) joint strategy building and foresighting in the value chain.

1. Introduction

Digitalisation is a challenging process that goes beyond digital technologies and their use within an organisation. It is argued that digitalisation should be understood as a socio-technical transition (Autio, 2017), whereby current technologies and related processes are replaced or supplemented by complex digital technologies such as the Internet of Things (IoT), augmented reality, Artificial Intelligence (AI), Blockchain, and Digital Twins (Alm et al., 2016; Cearley and Burke, 2018). However, digitalisation involves, besides (in many cases radical) technological change, social, institutional and economic change and is often synonymous with disruption, meaning that the outcomes significantly affect individuals, businesses, industries or society as a whole (Kilkki et al., 2018; Millar et al., 2018; Schneider and Kokshagina, 2021; Schuelke-Leech, 2018). At the same time, the exact outcomes (e.g. changed strategy, business models, and market positions (Autio, 2017; Nambisan et al., 2017)), as well as the process leading to these, cannot be predicted, resulting in considerable uncertainty (Agogué et al., 2017; Haefner et al., 2021; Schneider and Kokshagina, 2021).

For complex digital technologies to optimally function, data needs to be shared between different actors in a value chain (Wolfert et al., 2017b). In turn, it is argued that such data sharing enables realizing the benefits of these digital technologies, e.g. transparency and flexibility in the value chain(Ng and Wakenshaw, 2017; Wolfert et al., 2017a), as well as enabling more efficiency, increased productivity and sustainability (Jakku et al., 2019; Wolfert et al., 2014). Data sharing is hence often dependency-driven (Yang et al., 2021), as organisations do not have all the underlying technology under their own control, and as such depend on others to enhance their digital processes (Parida et al., 2016). Digitalisation thus requires collaboration which according to (Snow et al., 2017, p. 6) "*has been shown to reduce risk, speed products to market, decrease the costs of solution development and process improvement, and*

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enable access to new knowledge, technologies, and markets" (see also Barbour et al. (2017); Jakku et al. (2018); van den Broek and van Veenstra (2018)). As a result, organisations are becoming more connected, both literally and figuratively, further strengthening the already existing strong interdependence among value chain actors.

In the collaboration among interdependent value chain actors trust plays a key role (Falkenreck and Wagner, 2017), in particular in new and uncertain situations as trust helps to deal with complexity (Lang and Hallman, 2005). Trust in relation to digitalisation seems to work in two directions. First, digitalisation affects existing trust as digital technologies have the potential of transforming roles and power relationships. Hence it may put pressure on existing networks and relationships (Bronson and Knezevic, 2016; Jakku et al., 2019; Wolfert et al., 2017a). This can have a positive result, for example when trust is built through the use of digital technologies, as described by Agyekumhene et al. (2018), but digital technologies can also cause a decrease of trust in, for example, buyer-seller relationships (Falkenreck and Wagner, 2017). Second, trust is often a prerequisite for digital technologies to be adopted (Jakku et al. (2019). That is, digitalisation can affect trust relations, and vice versa trust is often required for digitalisation (Fielke et al., 2020; Fromhold-Eisebith et al., 2021).

Thus far studies often only focus on one direction in the relationship between trust and digitalisation, namely how (existing) trust affects digitalisation processes. In particular, many studies have been researching the role of trust in relation to digital technology adoption (Arfi et al., 2021; Califf et al., 2020; Julsrud and Krogstad, 2020; Kopyto et al., 2020; Kowalski et al., 2021; Liu et al., 2021; Luo et al., 2020; Pérez-Morote et al., 2020; Shareef et al., 2021), and other authors studied how trust affects the (digital) innovation process (Elia et al., 2020; Gupta et al., 2019; Linde et al., 2021; Nestle et al., 2019; Vicente-Saez et al., 2020). For example, in a study of transformation of the German textile industry, Fromhold-Eisebith et al. (2021) found that distrust between firms obstructs constructive inter-firm collaboration for digitalisation, and Jakku et al. (2019) found that distrust in data and those that control it hinders the setting of effective standards for data infrastructure and management.

Despite that previous authors have looked at how trust affects digitalisation processes, a more reciprocal understanding of the mutual relationship between trust and digitalisation of value chains however remains limited. This implies that, going beyond analysing how trust relations affect digitalisation, there is a need to also understand how digitalisation in turn affects trust relations among value chain actors. Analysing this phenomenon is especially relevant when looking at value chains in incumbent sectors and industries in which digitalisation comes in as a potentially disruptive force (Fromhold-Eisebith et al., 2021; Rijswijk et al., 2019; Sraml Gonzalez and Gulbrandsen, 2021). This paper aims to address this gap on reciprocal relationships between trust and digitalisation, by studying value chain dynamics in the incumbent Dutch flower sector, and the main research question that guides this enquiry is: *How do trust dynamics in value chain collaboration develop in the digitalisation of incumbent industries?*

In the remainder of this paper we will first present an analytical framework to link the concepts of (various forms of) trust to value chains and digitalisation. In the methodology section we will give a more detailed case description of the Dutch flower sector and known uncertainties. We then present findings about the role of trust in the navigation of digitalisation of this sector, and how digitalisation impacts on trust. This is followed by a discussion of the implications of these results in terms of enabling and constraining factors for digitalisation of value chains more broadly. In doing so, our paper shows how trust is a key enabler for digitalisation in value chains, while at the same time digitalisation may result in both distrust between stakeholders. Moreover, we show that joint strategy building and foresighting are key to trust building.

2. Trust and digitalisation dynamics in value chains

We will now outline the main concepts and insights from the literature that informed our empirical analysis, starting from trust and trust dynamics, its role in value chains, and how trusts and digitalisation are connected in these contexts.

2.1. Trust in value chains

Trust is seen as essential in many collaborative relations between actors (Stern and Coleman, 2015). Trust between actors, or interpersonal trust, can be defined as: "*a truster A trusts (judges the trustworthiness of) a trustee B with regard to some behavior X in context Y at time t*" (Bauer, 2019, p. 2). Following this definition, trust is context specific and time bound, between trusters (subject) and trustees (object of trust). In interpersonal trust relations in agri-food value chains, objects and subjects of trust are often value chain actors (i.e., farmers or growers, suppliers and processors or service providers). Interpersonal trust relations between these actors affect the success of collaboration, as successful collaboration itself can also contribute to trust development (Ramanathan and Gunasekaran, 2014). In addition to trust in persons, in agri-food value chains objects of trust could also refer to (governmental) institutions. Trust in institutions is distinct from interpersonal trust as it refers to generalized trust placed in abstracts systems, a feeling of taking for granted that they will function as they always do (Luhmann, 1979, 2000; Rothstein and Stolle, 2001). Trust in institutions therefore tends to lead people to take expected courses of action for granted without considering alternative options. This can enhance the stability of value chains, but it might undermine adaptability and transformability.

The judgement whether to trust or not is largely based upon (prior) experiences and collective histories (de Vries et al., 2017), e.g. what we know about the other. These experiences may create positive expectations resulting in trust, or uncertainties and risks (Stern and Coleman, 2015), e.g. when past digitalisation processes failed and resulted in financial loss, new initiatives will be viewed as risk taking impacting trust relations in a negative way. In trust literature, two distinct types of trust are often described (Rousseau et al., 1998). First, calculative trust; if prior experiences are sparse and relations are relatively new, they often result in a more calculative and rational type of trust based on evaluations of specific events. Second, relational trust; when relations develop or are based on shared identities (Sraml Gonzalez and Gulbrandsen, 2021), trust tends to take a more relational characteristic as it is based on a general attitude or shared feeling of collectiveness, and less related to specific events (Rousseau et al., 1998). Understanding trust in value chain collaborations thus requires examining how different types of trust (institutional, interpersonal) develop under the influence of calculative and relational arguments.

Value chains are organised as sets of interdependent organisations and their representatives in a sequence of value adding activities to support end use (Sturgeon, 2001). The success of value chains is dependent on the horizontal and vertical relations among actors (e.g. suppliers, processors, and ultimately consumers), and how this is organised (Trienekens, 2011). Relationships can take multiple forms, and often there is a combination of competition, cooperation, and collaboration, whereby each form has an increased level of motivation and commitment to work together and share information (Snow, 2015). These relationships, or existing interdependencies, create a degree of certainty, or even predictability. In other words, actors generally know what can be expected given a certain set of circumstances. These circumstances relate to the organisations (suppliers, processors and competitors) you work with, the resources required, and the rules and regulations related to the product, service or process (Meijer and Hekkert, 2007). These certainties can be beneficial as they may lower transaction costs (Roba et al., 2019), but may also create constraining path dependencies and uncertainties when organizational roles and interdependencies are potentially disrupted (van Assche et al., 2013), for

instance in the process of digitalisation.

Digitalisation changes the nature and mode of information and information sharing (Mas and Gómez, 2021; Misaki et al., 2018), and as such impacts the relations among and roles of value chain actors (Steiner, 2017; van der Burg et al., 2020), for example enabling multi stakeholder platforms and communication (Schiavone et al., 2021) or enhancing the predictability of trade partners (Kowalski et al., 2021), and thereby the way value chains are organised (Charvat et al., 2018). In their review Fielke et al. (2020) argue that trust relations are also likely to change under the influence of digitalisation, affecting collaboration, information sharing and use, and the further uptake of digital technologies. Studying digitalisation in value chains thus requires focussing on how digitalisation disrupts actor interactions, how these interactions are organised and how this affects interpersonal trust and trust in value chains (Kassem et al., 2020).

2.2. Trust and digitalisation connections in value chains

The increasing scientific attention towards digitalisation in agri-food value chains shows a variety of perspectives regarding the impact of digitalisation on the relationships among actors in a value chain. Digitalisation may have several impacts, depending on the technology in focus, which would go beyond the scope of this paper describing all in depth. For example, it is argued that digitalisation enables real-time decision making on logistical streams, through by real-time monitoring of product quality by sensors and IoT at several places in the value chain, such as production, post-harvest, processing, transport, and retail. Blockchain technology is said to enable fairer and more transparent transactions and better information on provenance and quality standards (Kopyto et al., 2020; Rejeb et al., 2020; Zhao et al., 2019). Robotics may reduce the need for human labour (which is sometimes in short supply) for monotonous and repetitive tasks in several parts of the value chain, such as production and logistics (Martin et al., 2022; Rose et al., 2021). Digital twins allow for in detail modelling of several aspects of value chain performance and management, which supported by AI and can lead to autonomous learning and optimization of value chain management (Pylianidis et al., 2021; Verdouw et al., 2021). Some studies thus underline the benefit of digitalisation for actor cooperation by arguing that digitalisation potentially fosters transparency and efficiency (Kos and Kloppenburg, 2019; Kowalski et al., 2021; Zhao, 2013). However, other studies take a more critical stance when they show that digitalisation may re-enforce existing power structures (Beckeman et al., 2013; Bronson, 2018; Bronson and Knezevic, 2016; Carolan, 2017), and can even reduce trust among actors due to increased inequalities (Martin et al., 2022; Rose et al., 2021; Steiner, 2017; van der Burg et al., 2020).

Underlying these different statements is the fact that trust is context and issue specific as earlier noted. In other words, depending on the context where digitalisation takes place (e.g. high trust context), and the issue at stake (e.g. transparency towards consumers) existing trust attitudes towards actors or products/processes may impact the uptake of digital technologies (Balasubramanian et al., 2021; Kopyto et al., 2020; Misaki et al., 2018). Whereas the use of digital technologies might also alter ways of communicating, relations and as such trust between actors (Canavari et al., 2010; Charvat et al., 2018; Jie and Gengatharen, 2019; Misaki et al., 2018; Tamm et al., 2016), affecting the potential for further digitalisation.

Thus, digitalisation affects trust among individual actors as well as in the value chain, potentially affecting further collaboration and the uptake of digital technologies by incumbent value chain actors. Trust in these contexts therefore is dynamic; developing over time under the influence of past and ongoing actor interactions in a specific trust context. In this, trust can have a more calculative and a more relational character in which the latter is more likely to develop after actor relations have intensified. To understand the link between trust and digitalisation of value chains we have to focus on both interpersonal trust and trust in the value chain (e.g., the formal and informal relationships and - information and data related - interactions among value chain actors, both horizontally and vertically); how this develops over time; and how these trust developments influence both horizontal and vertical collaboration around digitalisation within the value chain; and vice versa.

3. Methods

In this study we used an explorative single case study approach (Yin, 2017), focussing on the Dutch flower sector. A single case study is defined by Stake (1995, p. 27) as *"an intensive, holistic description and analysis of a single instance, phenomenon, or social unit"* to which Denny adds that a case study allows for in-depth study of the development of a phenomenon in a specific geographical area over time (Denny, 2015). As such, a case study allows for a thorough analysis of trust dynamics over time in the Dutch flower sector.

3.1. Data collection and analysis

This paper is based on a two-step data gathering approach, meaning that there were two rounds of interviews with key respondents and informants, with a total of 33 interviews.

In the initial round, data was collected as part of the DaVinc3i Community project (2016–2019), which was set up to support digitalisation of the flower sector. To gain better insight into the barriers and opportunities for digitalisation of the Dutch flower sector, 15 exploratory semi-structured interviews were held with a range of interviewees, such as researchers, policy makers and representative organisations of various value chain actors (e.g. growers, transporters and traders). These respondents were obtained through purposive and snowball sampling, and beyond narrating their own experience as respondents, they could act as informants given that they had a broad overview of dynamics in the value chain. These interview findings were validated in a workshop, allowing for triangulation of the interview data, and were reported in another article (see Salvini et al., 2020).

The present article builds on and deepens these insights around the digitalisation process of the Dutch flower sector reported earlier (Salvini et al., 2020), by focussing on the role of trust. Therefore, in a second round of data collection another 18 semi-structured interviews were held in 2019 representing various stakeholders in the sector. The involved organisations were growers (5); transport companies (2); auction house (1); trade companies (3) and their representative organisation (1); retailer (1); service providers (4); and a university (1). All interviewees were again purposively selected based on their involvement in the project or through snowball sampling. The main requirement being that the organisation was actively considering or involved in digitalisation. The actual interviewees were thus those best placed within the organisation to talk about digitalisation in the Dutch flower sector (see Table 1 for an overview of interviewees).

The interviews took 1 to 1.5 h, were conducted face to face, recorded and transcribed. The interviews were semi-structured focussed on collaboration in the value chain; the digitalisation process; the uncertainties encountered; and the links between collaboration and digitalisation and vice versa. In addition, the interviewees were given the floor to bring up anything relevant, which was not yet discussed on initiative of the researcher (Emans, 2002).

The transcribed interviews were sent back to the specific interviewee for approval. The set of interviews was then analysed using ATLAS.ti (version 8 for Windows). The interview transcripts were coded. In the research, we followed an abductive approach (following Timmermans and Tavory, 2012), in which theoretical concepts informed the coding, and in which the empirical material was reflected back on theory in order to sharpen theories on trust, value chains, and digitalisation. Through this process of coding key topics were identified, and evidence is supported by relevant quotes, which are shown in the results section. In this process we started from our theoretical framework resulting in

Table 1
overviews of interviewees participating in the case study.

#	Role of interviewee	Type of organisation
1	Director/Owner	Grower
2	Director/Owner	Grower
3	Director/Owner	Grower
4	Director/Owner	Grower
5	Director/Owner	Grower
6	Director	Transport company
7	Director	Transport company
8	Project Manager	Auction house
9	Director	Trade company
10	Director	Trade company
11	Director	Trade company
12	Project Manager	Representative organisation
13	Director	Retailer
14	Director/Owner	Service provider
15	Director	Service provider
16	Manager	Service provider
17	Consultant	Service provider
18	Researcher	University

codes on 1. Challenges and uncertainties in the value chain, including non-, and pre-, digitalisation; 2. Type of trust, e.g. calculative, relational and other trust related topics; 3. Objects of trust, i.e. value chain partners to whom the uncertainty or type of trust is related. Using these codes, the dynamics in trust and development in digitalisation, as well as their interrelation were captured. This results in the storyline as presented in the results section.

3.2. Case description

The Dutch flower sector has a long standing tradition and an internationally leading position with an annual export value of €6.2 billion in 2019 (VGB, 2021), not only in growing top quality flowers and plants, but also being the main logistic hub for import and export of flowers and pot plants across the world (de Keizer et al., 2013; van der Vorst et al., 2016; Verdouw et al., 2013). See Fig. 1 of a simplified overview of the value chain. The success of this sector is based around intensive cooperation between the large number of heterogeneous actors, including growers; traders; auction houses; producer organisations; retailers; and a wide variety of (logistic) service providers (Salvini et al., 2020; van der Vorst et al., 2012; Verdouw et al., 2013), which also differ in size, type of ownership, focus (national/international), and particular product (Salvini et al., 2020). This results in a large variety of value chain configurations with products for example being sold via centralized points, such as auction houses, or directly between (multiple) traders, going to a variety of retail outlets (de Keizer et al., 2013).

The flower sector, however, also deals with a range of (known) uncertainties that are closely related to the sector's characteristics. There are, for example, a high proportion of small sized and family-owned businesses, be it growers, traders, or transport companies. These businesses value hard work and craftmanship regarding the product or service they deliver, and are typically very supply driven (Salvini et al., 2020). Moreover, these businesses often have employees with a relatively lower level of education, and a relatively high average age of business owners. This combination of factors often results in a focus on daily activities and operational problem solving, rather than a strategic view of their business and the wider sector (Salvini et al., 2020).

Additionally the sector deals with uncertainty around demand and supply of products due to the perishability of products and their dependence on weather conditions (Verdouw et al., 2010). Moreover, the flower sector is supply-driven, partially due to the relative inflexibility of production process of flower products. This also causes a mismatch between demand and supply, as consumers can only buy what is offered to them (Salvini et al., 2020). These demand and supply uncertainties are exacerbated due to global challenges, such as higher consumer demands regarding the quality of the products, transparency of the production process, and overall sustainability (Hajkowicz and Eady, 2015; Trienekens et al., 2012; Verdouw et al., 2010).

The above characteristics and existing uncertainties lead to a high degree of competition both horizontally between similar actors and vertically among different supply chains of the same product (Salvini et al., 2020), i.e. there is little differentiation, which puts additional pressures on the profit margins. At the same time the value chain actors have become used to these uncertainties and the related lack of transparency (Salvini et al., 2020), which creates information asymmetries between buyers and sellers and enables actors to gain a competitive advantage (Wever et al., 2012). To deal with this competition, business-level interests are given priority over sector-level interests, impacting on the level of collaboration to address sector-level challenges and opportunities (Salvini et al., 2020). This is further exacerbated by the sector representative organisations having a limited understanding of the needs of their members, and the termination of the commodity board for horticulture in 2015, which up to then undertook the role of sector coordination as an independent organisation (Salvini et al., 2020).

At the same time, the Dutch flower sector needs to innovate to maintain its leading position (Verdouw et al., 2013). So far, the Dutch

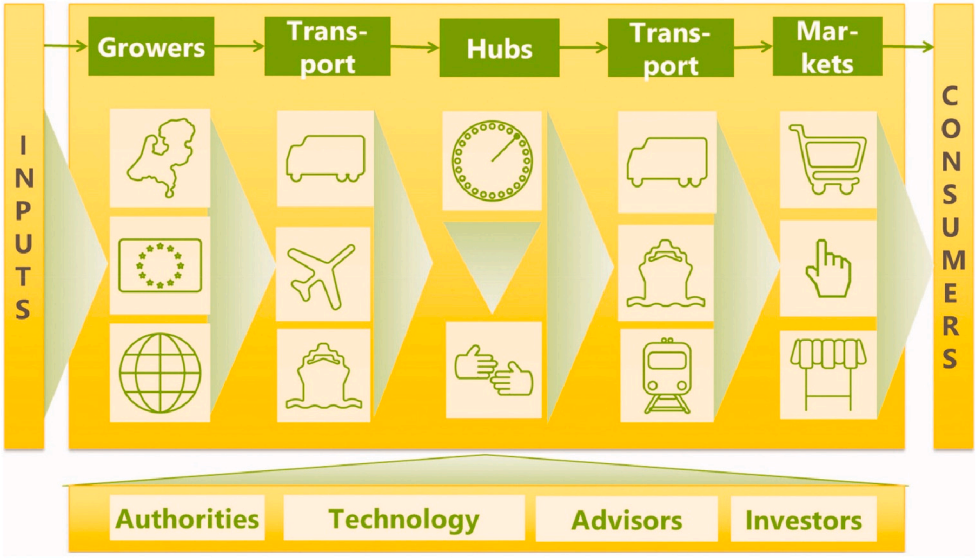

Fig. 1. Simplified value chain structure of the Dutch flower sector (Salvini et al., 2020, p. 4).

flower sector has progressed through product innovation, i.e. the breeding of flowers and pot plants. Furthermore, there has been process innovation within glasshouses to improve the growing process and enhance efficiency (see for an example of product and process innovation Verdouw et al., 2010). This nowadays also encompasses a range of digital technologies, for example the use of sensors to monitor and control the glasshouse temperature (RBC, 2019), or robotics for flower picking (van Henten et al., 2013). These processes are often referred to as digitisation (rather than digitalisation), whereby analogue information is converted into a digital form (Autio, 2017). These product and process innovations have contributed to the high quality and the high export numbers of the Dutch flower sector; however, they often occur at the business-level.

Like many other sectors and value chains globally (see for example Fromhold-Eisebith et al., 2021; Kiel et al., 2017; Klerkx et al., 2019; Kolloch and Dellermann, 2018; Mas and Gómez, 2021; Verdouw et al., 2016), the Dutch flower sector is also facing digitalisation (Verdouw et al., 2013). Digital technologies can allow for better monitoring and control of the products in the value chain, which enhances the quality, and allows for the development of services that focus on consumer and customer needs (Cenamor et al., 2017; Verdouw et al., 2013). For example, through global tracking and tracing of products with RFID tags, to measure temperature and humidity, which impacts on the flower quality and therefore the so-called 'vase life' of these flowers; or the (potential) use of IoT in trucks to identify the product location during transport for a better prediction of ETA; and the use of various types of online platforms to support trade. Digitalisation is however perceived as challenging, or even daunting, as it is not always well understood. Various actors perceive it as complicated and may also find that digitalisation negatively impacts on their competitive advantage (Salvini et al., 2020), while others are aware that you need to collaborate, for example through data sharing (Salvini et al., 2020).

In other words, digitalisation is the next step in maintaining the strong export position and high-quality standards (Verdouw et al., 2013). Although, understandably, the combination of the above-mentioned key characteristics, existing uncertainties, and digitalisation is challenging for the actors in the Dutch flower sector. Beyond yielding specific insights in the context of the Dutch Flower sector, we believe the case is also interesting and yields broader insights that relate to other incumbent sectors where digitalisation is a key challenge and is seen to affect and potentially disrupt many existing relationships and transactions, as has been observed earlier in the New Zealand agricultural sector (Rijswijk et al., 2019), German textile sector (Fromhold-Eisebith et al., 2021) and Norwegian newspaper sector (Sraml Gonzalez and Gulbrandsen, 2022).

4. Findings

In this section we explore the level of collaboration, interpersonal trust, and trust in the value chain in relation to digitalisation. We do this by describing the trust situation prior to digitalisation, then explore, through two examples, how digitalisation occurs within the flower sector and how this effects/ and is affected by existing trust relations.

4.1. Collaboration and trust development in the Dutch flower sector

The Dutch flower sector is characterized by a long-standing tradition of working together with many growers and related businesses in a relatively small geographical area. This has as an effect that within the Dutch flower sector "*everyone knows everyone*". A service provider said: "*You operate in a sector where everyone talks to each other*", and an interviewee from a representative organisation stated: "*It is a small world. Everyone knows each other, especially in the Aalsmeer region. Behind the scenes more things get discussed and decided than through official ways. That is typically the Dutch flower sector*". As such, the flower sector can be characterized as an informal sector with a basic level of trust.

The high degree of informality emerged partly due to the lack of regulation in the sector. The flower sector of course must adhere to trade and financial rules, and at the level of the grower there is basic regulation regarding phytosanitary standards and crop protection. However, over time the flower sector has known a lot less regulation compared to other agricultural sectors as it is a non-edible product and does not have any further requirements down the value chain. This impacts the way of working, or as a trader mentioned: *"Due to the lack of regulation regarding food safety, we do not have good and mandatory structures or supplier obligations to meet certain requirements. […] There is also a lot of cheating between the administration and reality going on, often undeliberate."* This was further confirmed by a service provider: *"If there is no regulation and you don't have to demonstrate anything you get a free-spirited culture. […] And as long as you pay, you can do whatever you want. Then you get individual behaviour"*. This flexibility supports trust between people in the same business or with the same interest, while it also results in uncertainties and puts pressure on trust relations between others, especially competitors.

The flexibility is therefore another characteristic of the sector and relied upon by all types of customers. In other words, they trust the chain and the actors working in it to be flexible, or as a transporter explains: "*With this customer you should do a bit more of this, and with that customer you should do a bit more of that?"*. Among the interviewees it is also felt that this flexibility is needed, to remain competitive. However, the flexibility also creates uncertainties, as the same transporter continues: "*You want to standardise, but at the same time you also want space for exceptions."* These uncertainties and the need to stay competitive have a great impact on the way collaboration is organised in the value chain, and the character of trust relations.

4.1.1. Vertical collaboration

Despite this culture of 'everyone knows everyone', the collaboration is characterized by calculative trust among value chain partners as it is mostly based on series of transactions of flower products or related services. In this process the auction developed into a key player, which is historically, the market enabler between producers and buyers of which growers are (and have to be) members of to sell their products. Furthermore, they hold a monopoly on dealing with transactions and finances between growers and traders. Additionally, they organise and manage the stacking trolleys used for transport of flowers and plants. Hence, this resulted in the situation that they function as a pivot point within the regional flower market and between the regional flower market and the world. Despite the long standing role the auction plays, the relation with other actors is mainly based on business transactions. Or as a service provider shares: "*It is a case of culture, 100 years in which the auction clock has played a central role. And by definition a transaction model in which the relationship whereby the customer is called 'buyer', that is saying something. There not really a relationship, let alone a partnership*." This business-oriented attitude with no openness, resulted in distrust from other actors towards the auction, as the service provider continues to explain: "*And this culture has created some distrust, keeping the cards close to the chest."*

Despite their historically solid position, increasing digitalisation has resulted in more direct trade taking place between growers and traders, making the auction less relevant. This created uncertainty for the position of the auction and consequently the auction decided to become more directly involved in the buying and selling of flowers. This radically changed traditional roles and moved the auction into the territory of traders, which in turn created uncertainties for traders. The – already thin- trust relations between the auction and trades became even more under pressure, in particular because the auction has a lot of insight into the pricing of products due to their financial role, which is the kind of information that traders are lacking, i.e. making the traders more vulnerable. In summary, trust was mainly based on calculative arguments due to historic relations and interactions, and came under pressure due to digitalisation, related changed roles, increased uncertainties

and feelings of vulnerability. However, both have reported that the trust relation is slowly improving again.

Not only the relationship between the auction house and the traders has changed. Growers and traders have also had a long-standing history of transactional relations and low trust. In interactions between these groups of actors only the most necessary information was exchanged and as such no relations of shared identities developed. Or, as a service provider illustrates: "*A history of limited relationships and maybe some distrust, although this mainly stems from growers towards traders […] based on who did the real investment in the production process.*" However, this trust relationship is also improving due to the direct trading taking place, as he continues to say: *"Although this sentiment is slowly decreasing, and the vertical connections are improving.*"

4.1.2. Horizontal collaboration

While there is gradual improvement with regards to vertical collaboration, horizontal collaboration among groups of actors seems to be even more challenging. Competition for market share plays a major role in the lack of horizontal collaboration and thus trust development. Among growers there are various experiences with horizontal collaboration. One grower of indoor plants mentions: *"There is no real collaboration. It takes effort to get everyone together and all those growers are very stubborn. Everyone finds his own ideas best and his own process most important."* A trader, who previously worked for a grower, had similar experiences: *"I have seen many collaborations between growers over the years, they always end up fighting. […] because it is about 'what is in it for me'."* The same grower also states that collaboration with other growers is difficult, simply because there are too many growers which creates competition. As such, many trust relations developed based upon calculative transactions. Or as a grower explains about collaborations between bigger and smaller companies: *"[we are] dependent on these small family-owned business, while we are a serious business. They are too, but at a different scale. And if they want to collaborate, they usually only come to get something, but bring very little. […] You must collaborate, but that must be based on equality."* The lack of relational trust is striking as most of these businesses have known each other for generations.

Despite the transaction-oriented character of the relationship, collaboration among growers does take place. Examples are study groups, marketing groups, or grower groups linked to the auction. However, opinions about their usefulness and the level of collaboration vary among the growers. The grower mentioned above perceives them as a collection of 'talk groups', as they take too much time and where *"… very little is said. Everyone pays attention to what they are sharing and how they say it. People come to get something and not to give anything."* Another grower (of garden plants) does see the benefits of these different groups as a lot of information gets exchanged about different topics, however *"the competition is steep and with regards to some topics businesses seem to increasingly shut their doors. […] Such as marketing and product development."* An orchid grower adds to this that there is a necessity to collaborate with other growers because both trade companies and breeding companies are consolidating and continue to grow and *"you do not want to get stuck in the middle."* Hence, they are also collaborating to be an equal partner in the value chain. So the horizontal collaboration is not always appreciated, and when it is then the purposes are varying, but above all this collaboration does not seem to enhance trust relations.

This is partly due to the fact that a culture grew in which critical data, such as financial data, is not (widely) shared due to fear of loss of their competitive advantage. But it really depends on the business size and what is at stake. For example on the hand there is a rose grower explains that he is happy to share both production and financial data, but only with a small group. He mentions that while they all compete, the total production of this group of growers is still relatively small on an international scale, hence that makes it easier to share commercially sensitive information. Moreover, he says it is about sharing your passion as well. A service provider, on the other hand, who supports a grower group that is linked to the auction perceives a lot of collaboration among growers, and said that there is *"enormous openness amongst growers, who sometimes also can be rampant, but the cluster [of growers] has become big through open innovation and knowledge sharing, etc."* In this latter example these are large businesses that all focus on a different type of flower product and therefore do not directly compete. In these situations trust is present, but only under certain circumstances or conditions.

These findings show that the decision to participate in these different groups itself is already calculative, e.g. 'what is in it for me', or 'how can we join forces against some other value chain actor'. This participation also comes with conditions, people are calculating regarding information exchange and have limited willingness to be open or vulnerable, or to show long term commitment which all affect trust relations negatively. Another example of that is provided by the traders, who have limited horizontal collaboration. If they collaborate, it is in subgroups, just as with the growers, often linked to the product they are trading or the size of their business. On top of that trade companies are increasingly growing and consolidating. A service provider states: *"Collaboration between trade companies hardly exists and is in fact always a deal. So, it is a business merger or takeover. The collaboration exists to some extent, also with their representative organisation, but it is not the main focus."* The representation organisation of the traders shared that *"bigger companies are increasingly collaborating in certain areas. [….] but you do see a difference between big and small companies. And that difference [in the ability to collaborate and reap the benefits thereof] is increasing."* Interestingly, the areas in which more collaboration takes place are usually non-competitive projects or topics such as sustainability of the products and of the value chain. Similar challenges appear in the horizontal collaboration between transport companies. A transporter remarked in relation to a joint transport network that *"collaboration remains challenging. […] Some companies thought 'nice, a network to make use of'. If there is a network it is all organized. But then you notice there is no commitment. […] So eventually we quit last year."*

In summary, horizontal collaboration among groups in the value chain remains challenging; characterized by calculative attitudes of actors, keeping their cards close to their chest. Although many actors acknowledge the importance of collaboration, especially to keep up with developments in the sectors, they are hesitant to engage in open relations. Consequently, trust relations are limited and characterized by calculative arguments. This has an impact on how the sector deals with new developments, such as digitalisation.

4.2. Digitalisation in the Dutch flower sector

As becomes clear from Section 4.1, digitalisation is slowly increasing its role in the Dutch flower sector impacting the sector in many forms. Consequently, value chain actors are faced with uncertainties and challenges. Despite these challenges effort has been put into the digitalisation process over the past decade in the Dutch flower sector. To gain more insight in these processes, two key example projects of digitalisation efforts will be highlighted in this section in relation to general digitalisation trends and their consequences in the sector. Both projects are related to online platforms, they were selected based on the type of collaboration in the value chain (horizontal and vertical), and the complexity of the digitalisation process; the first example is less complex compared to the second.

4.2.1. Data sharing through a trader foundation

The first prime example of digitalisation is a foundation that has been set-up and paid for by Dutch trade companies. This foundation monitors payment behaviour of (mostly foreign) debtors based on data and information automatically supplied by the traders who are members of this foundation, which is mainly an online platform making use of data analytic tools and models. The foundation had a government-based predecessor, through which trade companies had to share their sales information so that the government could monitor the export figures. This predecessor was, however, abolished in 2014. Since then, several

trade companies who valued the market and debtor information generated by this body started their own independent foundation. This foundation mainly provides a level of assurance around pending payments (i.e., when a trader receives money, they can subsequently pay the auction, the transporter, the grower, etc.).

Due to the monitoring role between debtors and clients, the foundation has a growing amount of data about actors and related transactions that can potentially be used for a wide range of purposes. However, even though they want to make more use of the digital data, the options for this foundation to make the most of the large amount of data that they receive are limited. First and foremost because the members demand anonymity and privacy. For example, when there is a problem with one of the debtors, who is a customer of multiple members, the foundation is not allowed to mention the member with whom this debtor has a problem, only that this debtor has a problem with one of the members. Moreover, that type information is only shared with the members of the foundation. The limited openness also prevented trust relations to develop quickly.

The foundation has therefore only recently begun to provide data analytics services, based on the data they collected throughout the past years. This for example involves sharing member data with trusted-third parties. These new services are only possible because it is their own foundation, which does not have a profit motive, as the foundation's manager put it: *"We've already built the trust, they [members] know what they can expect and that we are good at it."* However, before any additional activities (i.e., beyond providing market and debtor information to their members) can be started by the foundation all of the members have to unanimously agree, as they are the ones to pay for it themselves through their annual fees. This shows that the traders are very careful with data sharing, due to the high level of competition. In this case there is enough trust, due to long lasting one-to-one contacts between a single trader and the foundation, to allow data sharing beyond its initial intended use. Most likely, this is also because each individual trader can benefit from the additional services to enhance their own market share, i.e. it intensifies the competition.

Other interviewees also see the benefit of having such a foundation and the way it is organised. A transporter states that some of the debtors across the world repeatedly leave a trail of damage. Through the foundation the Dutch traders are covered. He refers to the limited sharing of data as following: *"[A trader might say:] That customer is coming from someone else, where he apparently was not paying. I do not need to know where exactly he was coming from, but I also do not want him."* A representative of the Dutch traders states in relation to the foundation that: *"I think it is important, that when it comes to confidential information, that you make agreements about it. […] They do not do anything else as always dealing with confidential data and in the meantime they have the trust."* Hence the trust is not so much in the partners themselves, but more so in the agreements they've made about sharing data, who has access to it and how it can be used, i.e. calculative trust.

Although the foundation is a unique and successful effort in sharing customer and sales data, it also shows that it was born out of necessity, starting with the government body. Hence it was more obligation, followed by habit, and benefits from the traders' competitive position, that led to the existence of the foundation. On the one hand it shows there is a degree of trust between traders, as it was a joint effort between participating traders to continue to share data and invest in the foundation after the government body stopped. Yet, the way it has been set up, as described above, also shows that this trust is very calculative and fitting with the competitive and transactional character of the relationships among the traders. As such the foundation does not necessarily enhance the trust between traders, only the trust or confidence in the foundation as an institution has increased.

4.2.2. Diverging and consolidating trading platforms

The second key example of both horizontal and vertical digital collaboration stems from the sprawl of various web shops and trade platforms that popped-up over the past few years, all aiming to bring demand and supply together, also using data analytics. This resulted in many different channels for growers to show their available supply and for traders to access that same supply. As growers advertised the same product on different platforms, growers ran the risk of selling the same product twice to different traders. The auction house took the opportunity and purchased a few of these platforms, solving this issue while at the same time establishing its position by creating its own platform. This platform connects to a broad range of existing web shops and other trade platforms, hence becoming a one-stop shop for growers and traders, and conveniently linking other (digital) service providers, such as transporters. However, according to a trader, this platform is members only, i.e. only the growers associated with the auction house can sell their produce on this platform. It also forces users (both growers and traders) to use the auction's financial infrastructure, while on the other hand it does not impose any requirements regarding sustainability and is unclear about data governance. The latter was also confirmed by a representative of the traders, who pointed out that the auction was running behind with agreements on data governance, especially as they were taking over a platform that was often used by the traders, i.e. trader data would not be safe anymore. This combination of factors made that the traders feel that their way of doing business and freedom of choice was being 'attacked', as the web shops and trade platforms provided a way to bypass the auction. Hence, this created more pressure on the already fragile relationship between traders and the auction.

Two large trade companies therefore decided to build their own platform, but quickly realised that they needed other traders to provide a powerful alternative to the auction's platform. Another 20 traders joined in building a 'traders' platform. A director from a trade company said: *"Two companies started [platform]. Maybe from distrust. […] Two leaders thought: it is not smart to do it together, let's see if we can involve more. […] And there is the recognition that two captains on one ship might not work. So let's see if we can create a certain mass, so that our leadership is supported by others."* A representative from the traders stated that *"You cannot make agreements with the auction as an individual [about data governance]. […] So you must do that together. And that trust you are only going to get at the moment you make agreements with each other, this is what now happened in [the traders platform]."* The creation of this new trader platform was perceived by other interviewees as a *"smart move"* from the traders, but at the same time they saw the new traders platform especially as a response to increased uncertainty and risks associated with the auction platform and consequently distrust in the auction. One interviewee captured it as: *"most traders are also a bit afraid of the auction"*. Hence the traders' platform created a sense of 'us against the big auction', fostering a drive to work together and stimulating trust development among traders based on shared experiences and a certain group feeling.

After a few years of both platforms existing a consolidation of the two platforms took place. This was somewhat expected by several interviewees, as consolidation is what often happens with innovations such as these digital platforms. As a trader summarised it: *"It [the traders platform] started as a counter reaction […] Then there was a factor from outside saying: 'This is weird what you are doing. Stop it. You think you can win? Hmm, no, then join forces. Join forces 'without losing face'. And then the next phase is to go show it. […] through their behaviour."* In other words, it was more like a forced marriage. As such, it does not mean there is more trust between the auction and the traders since they started to join forces via the platforms. This is illustrated by the way the merge came into being. The auction got a 50 % share in the traders platform, as they wouldn't settle for 49 % according to the trader. A service provider said: *"The auction bought them up for 50%, but you can't call it that way of course."* About the level of trust the trader adds: *"It needs more time. […] but sometimes things can go pretty fast. […] Initially there is a basic level of trust, full stop, but not more than that."* In this example eventually the feeling of 'if you cannot beat them, join them' prevails.

So, trust has been an issue within the Dutch flower sector well before

digitalisation began. Both vertical and horizontal collaboration has been challenging within value chains due to high levels of competition and other key characteristics, such as the heterogeneity of the sector. Despite the long-standing relations in the sector, this resulted in highly developed calculative trust, constantly balancing risks and uncertainties associated with the collaborations. While relational interpersonal trust slowly starts to sprout, and occasionally also institutional trust, it provided insufficient trust to pro-actively and jointly develop different kinds of digitalisation efforts that would support the sector. The two different types of platform examples and related data sharing, thus, have been born out of convenience and necessity, aiming to facilitate and maintain competitive advantages. In fact, not trust but distrust has likely played a role in both the development and the governance structure of these platforms, focussing on checks and balances. Consequently, digitalisation processes and platforms have not supported further development of trust between the stakeholders in both platform examples. At most a level of calculative trust or confidence in the governance structure ensuring that their data would remain safe and there would be no impact on their competitive advantage or position could be witnessed.

5. Discussion

In this article we aimed to address the gap in the literature on multifaceted aspects of trust in relation to digitalisation of incumbent value chains by taking a holistic view of the interplay between trust and digitalisation, by asking: *What are the trust dynamics in value chain collaboration for digitalisation of incumbent industries?* To answer this question, we focused on the Dutch flower sector and have shown the complex relationship between trust and digitalisation. We will now offer some wider reflections and theoretical and practical implications.

5.1. Limited trust hinders digitalisation in multiple and mutually reinforcing ways

The findings show that digitalisation creates pressure on the existing trust relations necessary for coordination and collaboration in the value chain. In turn these existing trust relationships are insufficient to support digitalisation of the value chain and to overcome its related uncertainties.

On the one hand we see that, in the case of the Dutch flower sector, digitalisation affects existing cultures, value chain relations, and ways of working, which create new uncertainties and risks. The sector characteristics and related uncertainties create a high level of interpersonal trust based on calculative arguments, but limited trust based on relational arguments at an institutional level, as the relationships among organisations, and their representatives are highly competitive and transactional. Not only these traditional arrangements based on calculative institutional trust are affected by digitalisation, but also the relational and informal aspects at an interpersonal level in the sector change. Especially as the increased transparency and predictably creates uncertainties about data use and sharing, putting pressure on mutual trust relations. This was also found by Legun and Burch (2021), who showed that the highly valued flexibility and informality within organisations and across value chains comes under increasing pressure as digitalisation creates standardisation of processes. Our findings are thus contrary to what the literature indicates about digitalisation leading to increased predictability of trade among partners (Kowalski et al., 2021), which is seen as an enabling factor for collaboration. The challenge of digitalisation being hampered by a sector's culture, characteristics and competition echoes findings by Fromhold-Eisebith et al. (2021) in the German textile sector. Furthermore Kolloch and Dellermann (2018) also found that the attitude and relations of the actors as well as the design, variety and type of technology involved highly impacted the outcomes of a digitalisation process; similar to the Dutch flower sector.

To overcome such trust issues governance arrangements can be implemented to foster more sustainable relations (van den Broek and van Veenstra, 2018). The Dutch flower sector, for example, already seems to have a so called 'market governance arrangement', which is short-term oriented, allows for autonomy of the involved actors, and suits the competitive nature of the sector (van den Broek and van Veenstra, 2018). However, it does not yet allow for longer term and more collaborative governance arrangements, which function as an enabling factor for digitalisation (Jakku et al., 2019; van den Broek and van Veenstra, 2018; Wolfert et al., 2017a), and which usually depends on, and fosters, strong trust relations (Nooteboom et al., 1997). Therefore it is crucial to move beyond the level of a contract, as contracts do not necessarily stimulate the further development of (relational) trust, but seem to be focused on accountability (van der Burg et al., 2020).

Digitalisation thus comes with the need for more transparency and openness, for which ideally there is true collaboration, rather than competition or cooperation (Jakku et al., 2016; Snow et al., 2017), based on trust. However, in the case of the Dutch flower sector the opposite seems to be true. Organisations are apprehensive about sharing data, and when they do it is under very strict conditions whereby the actual sharing is limited; often only with one other organisation. While this is understandable as it often involves sensitive business data, it also creates an even more competitive atmosphere, causing value chain actors to become even more cautious about data sharing, thus creating a vicious cycle. Instead of digitalisation functioning as an enabling factor for trust development through data sharing, for example through Blockchain technology (Centobelli et al., 2021; Hawlitschek et al., 2020; Kowalski et al., 2021), here it functions as a constraining factor.

The existing trust relationships in the Dutch flower sector thus hamper the uptake of digital technologies, a constraining factor also found by others (Balasubramanian et al., 2021; Kopyto et al., 2020; Misaki et al., 2018). The sector sits in between what Yang et al. (2021) describe as digital technology adoption level A or B: a relatively low technological intelligence and low to high supply chain collaboration. This has implications for future digitalisation pathways and efforts of the Dutch flower sector. When more complex digital technologies, such as AI, IoT and Blockchain are used by various sector actors, trust is still necessary and may even require active trust management by all parties involved (Kopyto et al., 2020; Myskja and Steinsbekk, 2020). Adoption of these kinds of technologies requires (upfront) trust building around the data and the technology, as well as ensuring that only trusted parties can access (sensitive) data (Balasubramanian et al., 2021; van der Burg et al., 2019). In the Dutch flower sector issues with trust in data and the technologies itself are present as well (Salvini et al., 2020), and while these issues are likely to hamper interpersonal and institutional trust development, they were not explicit in our examples.

On the other hand, while digitalisation in the Dutch flower sector to some degree enabled multi-stakeholder platforms and communication, we have also shown that these digitalisation efforts have not resulted (yet) in an increased level of trust among the involved actors. Digitalisation mostly seems to reinforce existing power structures within the Dutch flower sector, a constraining factor also identified in the literature (Beckeman et al., 2013; Bronson, 2018; Bronson and Knezevic, 2016; Carolan, 2017). Additionally, these efforts may potentially (negatively) affect trust in non-digitalisation collaboration efforts. The above shows that trust is a pre-requisite for the success of digitalisation, however the opposite, i.e. digitalisation facilitating trust development, has not been evidenced thus far. More importantly, digitalisation processes might negatively affect existing non-digital collaboration efforts.

Both horizontal and vertical collaboration, especially for digitalisation, thus remains challenging, despite some progress being made across the value chain. At most, the organisations work together at the level of 'co-opetition' (e.g., cooperation with competitors to maintain or increase the so-called 'pie', while competing with each other for a share of that same 'pie') (Bengtsson and Kock, 2000; Bouncken et al., 2018). The co-opetition element was also found in other studies, where it was described as a commonly found mechanism around platforms functioning as intermediaries between competing organisations (Andersson

and Mattsson, 2016; Cozzolino et al., 2021). This also relates to the level of data sharing, which in our examples is more a transfer of data to a single entity, with the benefits still mainly belonging to the owner of the data, instead of sharing (Giesbers et al., 2021). Despite these sub-optimal conditions for digitalisation, we do see that digitalisation also takes place, albeit likely at a slower pace than in more optimal conditions.

In terms of theoretical implications, deepening earlier work on the role of trust in relation to digitalisation (Agyekumhene et al., 2018; Bronson and Knezevic, 2016; Fielke et al., 2020; Fromhold-Eisebith et al., 2021; Jakku et al., 2019) by specifying the sorts of trust involved, the case of the Dutch flower sector thus showed that while there are successful examples of digitalisation, this process was based on limited calculative trust, or even distrust, rather than relational and institutional trust. Hence, this may lead to suboptimal levels of trust or even induce a negative dynamic of accumulative distrust, which does not lead to true collaboration, but is always to some extent negatively affected by co-opetition. This indicates that different sorts of trust at different levels in the value chain (i.e., related to relationships) and in the digitalisation process (i.e. related to technologies and how they impact relationships) can lead to 'trust development lock-ins' where different sorts of existing and envisioned trust, but also distrust, lead to a stalemate which hinders digitalisation. Different sorts of trust and distrust thus need to be tackled in tandem and that future studies on digitalisation in incumbent sectors and industries need to better contemplate this diversity of 'trust arrangements'.

In the next section we reflect on what these findings imply for how organisations in value chains overall deal with and manage digitalisation.

5.2. The need for joint strategy building and foresighting for digitalisation of the value chain

Our findings show that trust in digitalisation, or lack of it, as discussed in the previous section is connected to the issue of uncertainty. In line with previous work (Falkenreck and Wagner, 2017; Fromhold-Eisebith et al., 2021; Kobos et al., 2018; Millar et al., 2018; Schneider and Kokshagina, 2021) we have seen uncertainty about the relationships with other actors in the value chain; the technologies involved; how to organise digitalisation processes; and what to expect from the outcomes, which in turn impact again on the market positions, business models, and hence the relationships and trust between the actors of the value chain.

In other words, the uncertainty related to digitalisation and related dynamics of distrust may cause a vicious cycle, which is difficult to break. These uncertainties described with digitalisation are not unique, but similar to other innovation processes, where we have seen that the trust in other actors in the value chain play a crucial role, as well as the technology, availability of resources etc. and the governance around it (Meijer and Hekkert, 2007). What our research adds to previous work on trust and digitalisation in agri-food and other value chains (Bronson and Knezevic, 2016; Eastwood and Renwick, 2020; Fromhold-Eisebith et al., 2021; Jakku et al., 2019; Klerkx et al., 2019; Newton et al., 2020; van der Burg et al., 2020; Wiseman et al., 2019), as well as previous work regarding (digital) innovation, disruption and uncertainties (Falkenreck and Wagner, 2017; Kobos et al., 2018; Meijer and Hekkert, 2007; Millar et al., 2018; Schneider and Kokshagina, 2021) is that it shows the intermingled nature of process and outcome in relation to trust and digitalisation. Our research also indicates that organisations and the value chains they operate in are often 'locked-in' to older technological trajectories. These path dependencies are difficult to overcome when there is a limited basis of trust, or even distrust, that supports a collaborative approach towards digitalisation and its possibilities. In a sense organisations or even entire value chains become 'locked-out' or excluded from new (digitalisation) opportunities, due to the level of (dis)trust (Newton et al., 2020).

A key implication for those concerned with managing innovation in value chains is that there needs to be sufficient space for exploration to see what the possibilities and challenges are in both the short and longer term. This supports breaking out of the vicious cycle whereby existing distrust or limited trust causes limited digitalisation, which in turn causes more distrust due to uncertainties around the digitalisation process, further increased by existing (technological) path dependencies, and allows organisations and value chains to move away from being ignorant and becoming transformer regarding digitalisation (Dufva and Dufva, 2019) This is to understand what digitalisation means for an organisation in terms of their identity (Rijswijk et al., 2019) and innovation process (Haefner et al., 2021). Since this is especially complicated for incumbent industries (Sraml Gonzalez and Gulbrandsen, 2021), such as the flower industry, there is perhaps also a role for so-called 'disruptors'. For example in the Dutch flower sector, these disruptors need to come from outside the value chain given the strong lock-in. However, this is not without risks as disruptors may threaten the status quo and enhance distrust. Disruptors thus need to create a sense of urgency and a common purpose, or function as an intermediary.

In order to reset trust relationships and overcome distrust, striking a balance between exploiting the certain current value chain configuration while having sufficient space to explore the uncertain new and future possibilities of digitalisation would be key (Lawrence et al., 2021; Turner et al., 2017). Joint exploration, foresighting and strategy building could allow actors to step out of their regular patterns of competition or co-opetition and to explore new levels of collaboration for digitalisation. It could support trust development in the data and the technology; among value chain actors and between them and potential disruptors; and allows for experimenting with suitable governance structures, also considering the accommodation of potential 'losers' which disruption inevitably evokes (Barrett et al., 2020; Herrero et al., 2021; Klerkx and Rose, 2020).

However, such a process may also lead to further lock-in in old trajectories when done in current configurations of the value chains, whereby differences between actors are not always well understood and the innovation process is not supported through joint exploration and strategy building (i.e., letting go of competitive relations). Additionally new digital technologies increasingly have their own agency – such as AI, making these technologies an extra (f)actor to take into consideration (Kolloch and Dellermann, 2018; Legun and Burch, 2021). These two aspects combined (e.g., old value chain configurations leading to further path dependency and agency of technologies) could indicate that the concept of a value chain with clear linear relationships and a clear division of subsequent tasks may no longer be sufficient. Tentatively, it may indicate that it is time to move to an ecosystem approach whereby these human and non-human actors operate in a 'value network' (Kolloch and Dellermann, 2018) in which reciprocity (and therefore trust) is an underpinning success factor (Pachoud et al., 2020).

5.3. Limitations

Though the case study gave a good insight in digitalisation dynamics, it is important to note that the results in the article are based on interviews from 2019. Due to the rapid innovation around digital technologies and the related digitalisation process (e.g., recent advances and investments in robotics and AI) it is likely that the Dutch flower sector now finds itself in a different position regarding trust and digitalisation. For example, more complex technologies might be implemented, both horizontal and vertical collaboration may have increased due to improved governance structures and hence more institutional trust may exist. Furthermore, due to the competitive nature of the sector, some interviewees may understandably not have been open about what new ideas, efforts and collaborations they were developing with regards to digitalisation in the Dutch flower sector, which could have slightly skewed the data analysis.

6. Conclusion

With this research we aimed to show the connections between trust and digitalisation in a holistic way, focussing on the multifaceted aspects of trust and digitalisation in value chains. Based on a case study of the Dutch flower sector, we showed that there is limited (institutional) trust in this sector to support digitalisation. This indicates that the different manifestations of trust (e.g., interpersonal trust, institutional trust, and trust in data and technologies) all play a crucial role in digitalisation and need to (positively) coincide to achieve successful digitalisation, both in terms of the process and the outcomes. Additionally, we have seen that the existing trust relationships and competitive incumbent context do not sufficiently allow for exploration to support digitalisation, even when this space is being created through dedicated projects (such as DaVinc3i Community), hence the process and the outcomes of digitalisation end up in a vicious cycle. Trust should therefore be a stronger focus in processes of joint exploration, foresighting and strategy building for digitalisation in incumbent sectors and industries. Future research could investigate ways to break out of this cycle, and differences in the pace of digitalisation in competitive, co-opetitive, cooperative and collaborative contexts.

These findings underscore the importance of understanding trust in relation to its specific context, e.g. value chain and sector characteristics, and to see trust as a reciprocal concept, i.e. to understand how trust and digitalisation in value chains develop in relation to each other. A main theoretical implication is that better awareness of mutually reinforcing trust or distrust dynamics and related virtuous or vicious cycles in relation to value chain collaboration for digitalisation are needed. Such an approach adds an interesting and novel perspective to existing studies on trust and digitalisation, that often hold an instrumental focus and provide limited insights into the factors and dynamics underlying the interrelation between trust and digitalisation. Such a perspective is highly valuable for future studies aiming to understand how and why digitalisation impacts trust, and broader social relations, especially in the early stages of digitalisation in which we, to some degree, seem to constantly remain due to the ongoing development of new digital technologies.

CRediT authorship contribution statement

Kelly Rijswijk: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Jasper R. de Vries:** Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Laurens Klerkx:** Conceptualization, Funding acquisition, Supervision, Writing – original draft, Writing – review & editing. **James A. Turner:** Conceptualization, Supervision, Funding acquisition, Writing – original draft, Writing – review & editing.

Data availability

The data that has been used is confidential.

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