DIGITAL VALUE CHAINS – A RESEARCH AGENDA

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Abstract: *Value chains have ever been subject to technological change. In recent years, digital technologies have enabled the rise of digital platforms that shaped how value chain players interact with each other whereby platform value chains reveal a specific architecture of a powerful platform core and a surrounding ecosystem of different players that participate in different ways in the value creation process. Most recently, new digital technologies such as Internet of Things and Distributed Ledgers like Blockchain are on the rise. These technologies can enable an interaction of different value chain players without the necessity of an intermediate, e.g., a platform core, which is subject to future research. This paper proposes a research agenda for this topic around three major areas: (1) the creation and maintenance of trust among value chain participants, (2) the way how coordination will happen between different value chain players and (3) which business models might evolve or disappear and how value creation and capture will look like once these digital technologies are utilized in value chains.*

Keywords: *Value Chains, Platforms, IoT, Blockchain, Distributed Ledger.*

Introduction

Throughout the last years, digital technologies have enabled the rise of digital platforms that transformed the way of value creation and value capture in value chains. Hereby profit pools of value chains (Gadiesh & Gilbert, 1998) and power patterns of value chain participants have changed, shifting significant power to those players who define the platform core and by this somehow control the interaction of all platform participants. In particular, the platform core connects different players and thus facilitates trust and interactions among participants and especially manages access to customers which has been considered as very powerful in academia (Cusumano & Gawer, 2012). Research on platforms has emerged throughout the last two decades whereby initial publications referred to the technicalities of platforms and more recent ones refer more to the architecture of platforms as new type of (digital) value chains.

Recently, new digital technologies are on the rise like the Internet of Things with connected physical objects and Distributed Ledger technologies like Blockchain. These technologies are technically capable to take over certain key activities that are currently being carried out by platforms, like facilitating trustworthy interactions between different value chain players and sharing data to create insights about important elements such as demand. This paper outlines what elements need to be considered and what key questions need to be examined by future research in order to assess the impact of these new digital technologies on the evolution of value chains.

Value chains

The concept of value chains originally stems from looking at different disciplines in one company that are required to create a final outcome, i.e., a product or service, and has been transferred as holistic concept to look at the joint value creation and value capture of different players or industries respectively. In classical linear value chains, the chain can be looked at subsequent steps, ranging from raw material to intermediates, up to the final product on consumer level. In some cases the term supply chain is used in a similar manner, outlining the interaction between different players in order to create a final product or service. Although supply chains and value chains refer to the same flow of goods, it is notable that each concept looks at this process from a different angle. In particular, the concept of supply chains aims to optimize transaction costs, i.e., improving timing and resource requirements. On the contrary, value chains look at the value being created and captured from a customer perspective. This explains why highly efficient supply chains can potentially fail to be effective as value chains if they do not create sufficient perceived value at customer level (Feller, et al., 2006). Based on this logic, it can be derived why new digital players can disrupt existing value chains as they do not necessarily need to disrupt the actual value creation process but put more emphasis on elements that are perceived as very valuable by customers such as convenience or flexibility (von Leipzig, et al., 2016) and hereby establish improved value chains. In line with this consideration, recent research states that existing value chains can be easily disrupted by someone who creates more value (Bughin & van Zeebroeck, 2017), referring to value chains being subject to constant evolution. Moreover, the concepts of supply chains and value chains can be distinguished by assessing governance as key element of both concepts. Hereby the concept of supply chains states that each player is responsible – and thus governs – its individual step whereby value chains can be governed by someone superior that is not necessarily involved tin the physical flow of goods (Timmer, et al., 2014).

Another angle to look at value chains are profit patterns, a concept being introduced more than two decades ago in order analyse the commercial attractivity of different value chain steps. The concept reveals that high net sales figures do not necessarily imply high profits being made as different value chain steps reveal a different degree of competition and/or are associated with different degrees of customers´ willingness to pay (Gadiesh & Gilbert, 1998). As a consequence, it might be much more attractive for focus on certain niches of value chains in order to optimize for profitability. As profitability is rather easy to identify by looking at cost being charged at each step of the value chain, it needs to be considered that profitability cannot directly be linked to value chain power. Examples could relate to value chain players who provide components which are critical to assemble final customer products although their profitability might be rather low compared to other value chain steps. In line with this, research states that different value chain steps show different degrees of power whereby a rather high degree is associated with the access to final customers (Mudambi, 2008). This could explain why many platform players have become rather powerful as they facilitate which platform participants get access to customers in order to offer their products and services (Parida, et al., 2019). Recent research states that many value chains have significantly increased complexity and rather became value creation networks with many players and interactions in recent years (Rejeb, et al., 2019). This will likely increase even more after the Covid 19 crisis in order to offer different alternatives within one value chain on a modular basis to ensure a stable value creation process (Strange, 2020) which pinpoints towards platforms who are by nature organized in a modular way.

Digital Platforms as new type of value chains

Digital Platforms are virtual collaboration spaces whereby the platform owner offers platform participants to jointly sell their products and services and create innovation together (Cusumano & Gawer, 2012) so that customers get access to a broad variety of offerings in a very convenient way (van Alstyne, et al., 2016) In that sense, platforms act as matchmakers. Platforms are not new but digital technologies have leveraged their rise as they help to foster elements that are perceived beneficial by customers such as convenience and freedom of choice (Constantinides, et al., 2018).

An essential question is to which degree platforms need to drive innovation among the platform participants and if pure digital marketplaces can be considered as platforms as well. Notwithstanding this conceptual discussion, recent research shows that many platforms do offer both, pure marketplace functionalities and also innovation spaces which might turn them into some kind of hybrids in practice (Riso, 2019). Throughout the last years, scholars´ attention is drawn from the technicalities of platforms towards their business models, i.e., the way how value is created and captured (Bonina, et al., 2021). In line with this, research reveals that platforms do differentiate from linear value chain as different players mingle around the platform which would be competitors in linear value chains. Consequently, competition on platforms is different from linear value chains and many players might end up in some kind of competition-collaboration dillema with shifting roles of the same players (Gossé, et al., 2020). Although platforms have been researched intensively throughout the last years, there is very limited research on the power patterns of platforms and especially on how ecosystem players can maintain and protect their position towards others in such a dynamic context (Giones & Brem, 2017). The reason why competition needs to be considered differently for platforms is the so called network effect. This means that the perceived value of a platform increases the more participants join the platform and interact on it (Cusumano & Gawer, 2012). Nevertheless, very recent research shows that network effects might prevail for platforms with rather complementary players and network effects might not be as strong if only similar players interact on the platform as this does not necessarily broaden the platform´s offering and thus does not increase perceived customer value (Bonina, et al., 2021). Other authors state that the degree of complementarity of platforms might in fact be positively correlated with increasing network effects (Zott & Amit, 2017) but on the other hand, players might be detracted from highly complementary platforms as they absorb more effort from each player and by this potentially distract them from joining other platforms at the same time (Jacobides, et al., 2018), although these dynamics might be subject to further research (Giones & Brem, 2017). Notwithstanding, research shows that network effects of platforms have the potential to disrupt existing linear value chains sustainably (Steur, 2018). Accordingly – and in contrary to linear value chains – platforms aim to optimize not primarily for perceived customer value but foremost aim to increase network effects and attract more and more players fast (van Alstyne, et al., 2016). Especially, this can be observed once new platforms emerge and put much more effort in increasing network effects and attracting ecosystem players than improving customer value at first (Korhonen, et al., 2017).

Some authors associate success of platforms with their degree of openness, i.e., how easily new ecosystem players can join the platforms (Kazan, et al., 2016) as this stimulates innovation. Most recent research states that many customers make use of platform offerings whereby they would not have used the individual service offerings of the respective ecosystem players before (Verhoef, et al., 2021). In line with this, platforms can not only create innovative offerings but can also innovate the way how value is delivered.

Nevertheless, recent research indicates that platforms might stifle their innovation capabilities once they start to put financial pressure to their ecosystems (Caplan & Gillespie, 2020), outlining that value capture is an essential element to assess platforms (Schor, et al., 2020).

Platforms reveal a special type of architecture as they comprise a platform core that facilitates all interactions and a so called ecosystem, a network of different players that jointly create offerings, whereby the platform utilizes insights on these interactions in order to stimulate new ones (de Reuver, et al., 2018). Hereby platforms are highly modular as they can assemble different players for different purposes and - by smartly combining these different players - offer a great variety of products and services to customers (Gossé, et al., 2020). In line with this sheer endless flexibility, platforms require a coordinating body that ensures that the right players provide the right solution at the right time (Phillips, et al., 2017). In context of new digital technologies that enable the interaction of different players without a central institution, it seems to be an open question to research what type of orchestration will be required then and how this will look like (de Reuver, et al., 2018). Some authors indicate that platforms are powerful as they can utilize insights they get from various transactions on the platform, behaviours from customers and ecosystem participants, in order to improve their offering (Bonina, et al., 2021) which makes the flow of information on platforms an important element. Comparing platforms with linear value chains, both concepts reveal advantages and disadvantages. Linear value chains are highly efficient as each player knows what to do at his individual step and thus optimizes accordingly. On the other side, platforms foster innovation and by this attract more and more customers. This might explain why some powerful platforms like Amazon do enter into linear value chains in order to combine best of both worlds. If this is a single case or an emerging trend is subject for further research (Constantinides, et al., 2018).

Although linear value chains have increased their complexity, the boundaries of value chains can be examined rather easily by looking at the value creation flow from raw materials to finished goods. This might look differently for platforms with an ecosystem of rather loosely connected players, especially if these players are active on different platforms and so different platforms´ ecosystems do overlap and knowledge flows from one platform to another. Generally, platforms are a rather fluid concept without a stiff hierarchy and ecosystem players shifting roles from time to time (Constantinides, et al., 2018). That being said, platforms are not easy to depict from an organizational perspective. Nevertheless, some authors refer to the importance of the platform´s technical nature with open interfaces enabling the flow of information and onboarding of new ecosystem players as determining factor, stating that the technicalities determine the organizational boundaries and not necessarily vice versa (de Reuver, et al., 2018). Although this might be a rather subordinated question at first sight, it could become much more relevant once looking at new decentral digital technologies like Internet of Things and Distributed Ledgers as their technical setup could shape the organizational development of associated value chains. In fact, platforms have been considered in past research via a rather simplistic view by mainly outlining specifics of either the platform core or the surrounding ecosystem (Bonina, et al., 2021). Due to the powerful and knowledgeable nature of the platform core, some authors put platforms even in the context of planned economies (Wang & Li, 2017). In line with this, it seems crucial to assess the location of intelligence on platforms in order to determine the associated power structures as different types of platforms can be observed, meaning that intelligence can be rather with the platform core or with the ecosystem players (Tiwana & Konsynski, 2010). The more intelligence is associated with the platform core, the more

powerful the platform core becomes, the lower the degree of innovation among the ecosystem players which in turn has negative impacts on perceived customer value. Decreasing customer value once again lowers the attractivity for other ecosystem players to join and by this network effects cannot come into play effectively (Constantinides, et al., 2018). Consequently, platforms will always have to balance between knowledgeable and thus powerful ecosystem players and a powerful platform core in terms of information advantages and thus superior intelligence, especially considering the fact that ecosystem players do show a rather low degree of loyalty and can easily switch to another platform (Farrell & Greig, 2016).

Derived from this, it seems that access to relevant and critical information is an essential pillar of value chain power and needs to be considered once exploring future platform evolutions. Exactly this consideration pinpoints towards the question how platforms – or generally value chains – can develop towards once digital technologies enable different players to communicate and thus cooperate more flexibly without a knowledgeable and thus powerful platform core.

Decentral Digital Technologies as shaping forces for value chains

As outlined, an essential element of value chains relates to access and flow of information whereby an immanent issue of value chains is information asymmetry as one player can have more (valuable) knowledge about relevant information such as demand, timing or willingness to pay than others. As the concept of value chains is thought from a customer perspective, it seems to be likely that those value chain players might have an advantage who gather insights on customer needs (Feller, et al., 2006). Due to information asymmetry, trust between different players plays an essential role. If value chain players are well known to each other and conducted various interactions among each other already, trust is likely established effectively already (Phillips, et al., 2017). On the flipside, this might not always be the case for unknown value chain players. Based on the nature of platforms as innovation spaces, new combinations of platform participants are facilitated within the value creation process on the platform and new combinations of different players emerge frequently. Hence, the element of trust strongly relates to ecosystem players on platforms as they are drawn together for a specific, often time-bound purpose in order to create innovative offerings. Hereby the platform acts as trust-building intermediate that facilitates the interactions between different players and acts as mediator if issues occur (Hesse, et al., 2020). Generally, this trust-building and mediating role might get even more important, once value chains get more and more globalized and relationships last rather even more shrotly (Schmidt & Wagner, 2019).

Furthermore, research shows that platforms make use of their insights on different players´ capabilities, expectations and demands in order to match the right players at the right time and by this establish and maintain trust as interactions likely turn out to be successfully once matchmaking is done in an effective manner (Kilhoffer, et al., 2017). To enable this, platforms act as data hubs that collect and process various data points from all players interacting on and with the platform. That being said, platform as central institutions are subject to data security risks. If platforms are attacked by hackers, they can potentially get comprehensive insights on various interactions and by this might have the opportunity to manipulate the flow of information and thus transactions on the platform. Recently, new digital technologies are emerging that are referred to as so-called Distributed Ledgers, e.g., Blockchain, whereby data is stored in a decentral manner, being distributed among many participants of a network. Hereby transactions need to be validated by all

players that store data – not only by a single, central institution like a platform core (Dufva, et al., 2017). Blockchains are a type of distributed ledger technology whereby data points stored as blocks among many participants and these blocks sum up to a chain, the blockchain. Thus, blockchains are decentral databases for keeping records of data transactions (Schmidt & Wagner, 2019). Blockchain users participate in the network and validate transactions with a special type of authorisation, a public-private key, whereby the private part of the key is only known to the respective user and the public part is open to all others (Christidis & Devetsikiotis, 2016). Generally, the blockchain technology could help to bridge connectivity issues of different platforms and digital networks (Rejeb, et al., 2019).

Blockchains can operate as public networks with open access or as private networks being restricted to only a limited number of users (Chedrawi & Howayeck, 2018), whereby private blockchains operate much faster as transactions only need to be validated by a known and limited group of participants (Christidis & Devetsikiotis, 2016).

Most recent research shows that these technologies can significantly increase transparency between different players in a value chain and by this potentially enable new ways of value creation and value capture (Parida, et al., 2019). Initial disadvantages of the technology refer to its high energy requirements (Constantinides, et al., 2018) and time-consuming nature as each transaction needs to be validated by every participant of the network so that the technology decreases speed once it gets scaled (Nikolakis, et al., 2018). In this context scholars consider the concept of Sharding as potential solution to this problem, meaning that different layers of distributed ledger technologies are established whereby validation happens only within one layer and once certain procedures are finished, a new digital object is created on a superior ledger (Rejeb, et al., 2019). Examples could relate to logistics whereby one layer validates transactions within one warehouse and once a truck is packed, a digital avatar of the truck is created on a superior layer of the network that validates transactions between different warehouses. By applying this concept, research emphasises on many opportunity areas for this technology and especially identifies the opportunity that those players can be replaced who currently take care of validation tasks such as certification, audits or simply granting access to certain areas (Li & Li, 2017). As some of those players who currently perform these tasks might serve as bottlenecks for the flow of goods and services in value chains, these technologies can have the potential to speed up those processes substantially (Nikolakis, et al., 2018). In particular, research outlines that these technologies can be used to substitute central institutions like platforms when it comes to their trust-building role (Chedrawi & Howayeck, 2018). Additionally, this might not only be true for value creation but also for the way how value is captured (Parida, et al., 2019), whereby so called smart contracts would play an essential role. These smart contracts automatically trigger certain activities once a defined prerequisite is met (Christidis & Devetsikiotis, 2016). Examples would be an automated payment once goods arrive at customers or an automated placement of orders once a sensor detects that a certain stock level is reached. Hereby Distributed Ledgers like Blockchains interact with the so called Internet of Things with connected physical objects and these technologies might account for new ways of value creation and capture and thus value chains (Constantinides, et al., 2018). In this context, some authors specifically ask how these technologies will impact the current way how platforms operate and if they would even account for new types of platforms (de Reuver, et al., 2018). Nevertheless, other authors state that also these technologies might require some kind of coordination (Jacobides, et al., 2018) although it is not clear how coordination will look like once these technologies come into play. More

interestingly, smart contracts could be used also for players who are not known to each other if one player meets the requirements being set by another player and then actions get triggered. Examples could relate to tendering whereby one player automatically wins a certain tender if a certain price point or qualitative requirement is met. This process would not require a qualifying institution as middle man and therefore could impact platforms strongly. Additionally, these new ways of interactions between different value chain players could enable that certain players might open their assets to be used by others once certain preconditions are met which potentially enables new business models and a more efficient overall resource allocation along value chains (Ehret & Wirtz, 2017). Nevertheless, other authors refer to data ownership being a significant hurdle while hypothetically assessing these new opportunities (Hein, et al., 2019). Additionally, some authors state that these considerations are based on one-sided optimism and need to be assessed in practice (Lember, et al., 2019). That being said, recent research clearly shows that these new technologies can leverage individualization and personalization as customers can be integrated in the value creation process much more easily (Zaidi & Belal, 2018) and by this new business models are likely to emerge (Ghanbari, et al., 2017). Authors postulate that these new business models can be strongly related to sharing or usage-based renting concepts (Suppatvech, et al., 2019) and are likely to be much more outcome-oriented than based on input factors (Giere, 2017).

Although an increase of smart objects in conjunction with smart contracts could enable a decentral digital economy, these objects need to seamless interact with one another which is considered as key challenge in current research (Noura, et al., 2019) as they literally need to speak the same language in order to be compatible (Hein, et al., 2019). Notwithstanding the technical issues that arise along these lines, the organizational implications of such digital value chains are subject to future research according recent publications (Schmidt & Wagner, 2019). In particular, this refers to the question on who is initiating these interactions and for what purpose, driven by what type of motivation and it also refers to the orchestration of those digital players once a network is established. In that context research points towards the nature of platforms that either arise if one player proactively aims to assemble more (complementary) players around in order to create network effects or that particular players gather around a certain customer need in order to provide a suitable offering (Ikävalko, et al., 2018). The latter might give an interesting hint on the evolution of value chains once the before mentioned technologies are utilized as they value proposition for customers is key driver to create new business models and transform value chains sustainably (Metallo, et al., 2018).

In essence, it seems that these new decentral digital technologies can have an impact on value chains and on platforms in particular. Existing business models might likely not be sufficient to capture the all the opportunities of Internet of Things and connected assets as recent a study for industrial setups reveals (Ehret & Wirtz, 2017). Accordingly, it needs to be explored what new forms of value chain organisations might be required then.

Future implications & proposed research agenda for digital value chains

Value chains have been subject to constant development ever since. Especially, new technologies have contributed to the evolution of value chains, both from the perspective of customers but also from the viewpoint of producers. In line with this, lines between these two types of value chain participants became blurry as new forms of value chains like platforms emerged.

The rise of platforms was triggered and supported by digital technologies whereby platforms have disrupted many linear value chains and enabled new business models accordingly.

In line with this, new decentral digital technologies in context of Internet of Things and distributed ledgers can potentially trigger a further development of value chains and by this potentially transform platforms as we know them today. As research is in generally very limited when it comes to power structures of platforms, it is an open question for research how power pattern of value chains might evolve once these new decentral technologies are applied. Notably, three major research areas can be identified that are subject to further research:

(1) Trust & Mediation

As outlined by various others, new decentral technologies are technically capable to validate transactions via a decentral approach und thus distribute power of validating institutions among various parties of a network, i.e., a value chain. Currently, superior institutions serve as trust-builder, such as banks or also the platform core for platforms. In line of those new decentral digital technologies it is an open question if these technologies would not only be technically capable to establish trust among different (unknown) value chain players but also to perform this effectively in practice.

Furthermore, it is subject to research how these technologies come into play once conflicts between different value chain players arise and if they can be utilized as mediating instrument in these cases.

(2) Value chain coordination

As outlined by the research around value chains and supply chains, scholars assess how well transactions are coordinated between different parties within one value chain, whereby the concept of value chains puts strong emphasis on the perceived value at customers and the supply chain perspective looks after efficient flow of products and allocation of resources. Accordingly, it is subject to research how these new technologies can be utilized among different value chain participants for effective and efficient resources allocation. In particular, future research needs to assess how these technologies will work out in terms of matching the right players for a particular purpose at the right time in order to meet customers´ expectations and by this pay into (and improve) perceived customer value.

(3) Business model enablement, value creation and value capture

The flow of data between various digital objects and thus parties can significantly improve data transparency across value chains. Consequently, it will be subject to research what type of new business models will be enabled by these technologies and in particular, how value creation of (different) value chains players will look like. For value capture it might not only be subject to research if these technologies can be used to maintain existing value capture schemes but also enable new forms of how value is captured. Additionally, it needs to be explored what type of business models might disappear due to the deployment of these technologies.

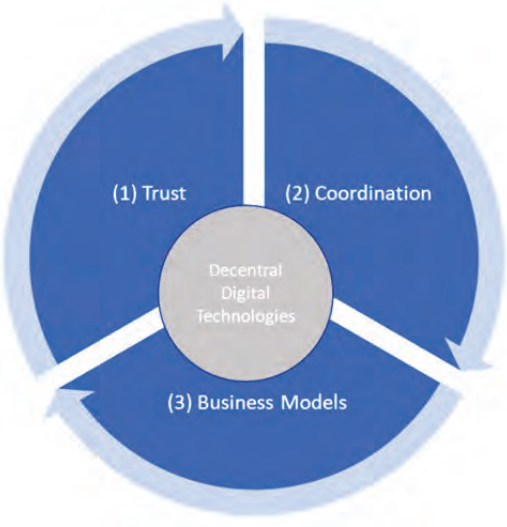

Figure 4: Schematic Graph of 3 research areas

These three elements can be observed in an isolated manner although they are somehow connected with each other as trust serves as basis for any kind interaction between different value chain players and thus is the prerequisite for a coordinated value creation process. New forms of coordination might trigger and impact the evolution of new business models whereby these business models can form the basis for trust among different value chain players as they can participate from the value being captured along the value chain. Accordingly, it is suggested for future research to explore these three elements in conjunction due to their interconnectedness.

Conclusion

Decentral digital technologies can potentially shape value chains as we know them today. As outlined, the question if and how this could happen is subject to future research. In particular, scholars need to explore the implications of these digital technologies on trust, coordination among different value chain players and the enablement and disappearance of business models within value chains. This paper´s aims is to provide guidance on particular areas for future research projects in order to explore and capture the potential impact of these new technologies on future value chains comprehensively.

As these technologies might serve different purposes in different value chains of different industries, it might be suitable to assess and compare different industries in order to draw conclusions on overall implications of these technologies for future value chain evolutions.

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