The Impact of Digital Technologies on Services Characteristics: Towards Digital Servitization

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Abstract. Despite that digital technologies play a fundamental role in enabling innovation in service delivery processes, the understanding of how they influence services characteristics, and service provider – customer interactions still remains a critical point. On these premises, this paper introduces a study to explore such influences, through the adoption of a two-dimensional matrix, representing a service provider – customer interaction typology, and describing how digital technologies influence the five main services characteristics (viz. intangibility, inventory, inseparability, inconsistency, and involvement). The matrix was built upon a literature review, and further refined through brainstorming sessions with researchers and practitioners. The results found suggest that digital servitization, the "digital transformation of services", brings about new dynamics in service provider – customer interactions by impacting on the service delivery processes elements. For this reason, the achieved matrix can help service researchers and managers to understand how digital technologies increase/decrease the presence and the role of the service provider in a service delivery process, and the presence and the role of the customer of the service in a service delivery itself.

Keywords: Service Systems, Product-Service Systems, Digitalization, Digital Technologies, Services Characteristics, Service Provider, Customer, Interactions.

1 Introduction

Recent studies have addressed the role of *digital technologies* in services and product-service bundles delivery processes towards *digital servitization* [1] [2]. As suggested by [3] & [4], the *digitalization of services* influences the nature of a service itself, including its characteristics, since it implies a "(re-)organisation" of the service delivery process. Despite the large interest of research towards digital technologies in the service industry, often too little attention is still given to exploring how *services characteristics* [5] are evolving when *digital technologies* [6] are introduced in service delivery processes, thus, creating new forms of *service provider – customer interactions.* Such knowledge would instead allow to better develop and organise processes and resources, as well as to identify the most suitable digital technologies (e.g. see Table 1) to be adopted for a specific service or product-service delivery solution. In such a context, this paper aims to analyse how *digital technologies* influence the *characteristics of services* in existing and new service provider – customer interactions as they are digitalized in B2C & B2B domains. To do this, we classify digital technologies in a two-dimensional matrix, and use this categorisation to verify how they affect each of the "characteristics of services".

Table 1. Digital Technologies and their Impact on Services: Examples

Augmented Reality (AR) / Virtual Reality (VR)	• AR / VR can improve customer support agents training. • AR / VR can enrich services "tangibility", thus, customer experience.
Autonomous Guided Vehicles (AGVs)	• AGVs can support service delivery processes (e.g. logistics services).
Chatbots	• Chatbots can improve the availability of customer service and support.
Big Data Analytics (BDA)	• BDA insights integration with human, assisted, or automated service delivery processes can ultimately improve customer experience.
Cloud Computing (CC)	• CC resources "elasticity" can offer at each point in time the needed resources to match the current service demand as closely as possible.
Horizontal Integration (HI) / Vertical Integration (VI)	• HI / VI can improve service delivery processes, and services quality, by enriching the value creation capabilities of a service value chain.
Internet of Things (IoT)	• IoT can improve the delivery of current, and provisioning of new services to smart, connected products & assets (e.g. product-services).
Simulations	• Advanced simulations will continue to support the design of services.

2 Services: Categories, Characteristics, and Types of Interaction

Among different perspectives and interpretations of *service features*, the majority of studies in the service domain attribute five distinctive characteristics to *services*, also known as the five "I's" [5]. These are: (i) *Intangibility*, since services are intangible; (ii) *Inventory (perishability)*, since services cannot be stored; (iii) *Inseparability*, since service provider is indispensable for a service delivery; (iv) *Inconsistency (variability)*, since each service is unique; and (v) *Involvement*, since services require customer participation in the service delivery process.

Based on these characteristics, different classification methods both in marketing and in services operations management areas have been developed over the years to describe the main service dimensions and their relationships [7]. An exploration in the field of *service process delivery* has been carried out to develop a better understanding of how *service provider – customer interactions* co-create value in the emerging *digital servitization domain* [8]. In this context, [9] have proposed a service classification, where the level of participation of the customer in the service delivery process goes from (i) *self-services*, defined as "services in which there is no direct assistance from or interaction with a human service provider" to (ii) *super-services*, defined as "services in which there is no direct participation of the human customer". On the other hand, [10] has proposed a classification where the level of participation of humans goes from (i) *human-services*, defined as "services in which there is direct assistance from or interaction between the human service provider and the human customer" to (ii) *autonomous-services*, defined as "services in which there is no interaction between the human service provider and the human customer".

Hence, based on the categorisations of [9] & [10], we can argue that in a *digitalized service delivery process*, four types (i-iv) of *service provider – customer interactions* can exist. These interactions depend on: (a) the presence (i.e. yes/no) and the role (i.e. active/passive) of the service provider in a service delivery process, and (b) the presence (i.e. yes/no) and the role (i.e. active/passive) of the customer of the service in a service delivery itself. Table 2 describes the four *types of interactions* that have been identified in this research: (i) *Human to Human (H2H)*, where digital technologies do not modify

the “active role” of the human service provider, neither the human customer, in the *human-service* delivery process. However, they can create new forms of or enrich their interactions (e.g. augmented reality, virtual reality, mixed reality, and haptic devices), or allow these interactions to take place remotely and in real-time (e.g. phone-calls, instant messaging, and video conferencing); (ii) *Human to Machine (H2M),* where digital technologies enable the possibility of a human *self-service* process, thanks to an intuitive human-machine interface already available in the machine service provider. Within this type, the human customer is the only “active part” in the service delivery process; (iii) *Human to Machine (H2M),* where digital technologies allow the possibility of a *super-service* process, thanks to remote operation capabilities. These capabilities allow the human service provider to act on behalf of the customer, and make the human customer a “passive entity” in the service delivery process; and (iv) *Machine to Machine (M2M),* where digital technologies create an *autonomous-service* delivery process, thus, making unnecessary the existence of a human-machine interface in order to deliver the service. Therefore, both human service provider, and human customer presences are “passive” or “inexistent” in the service delivery process.

Table 2. Service Provider – Customer Interaction Typology

	Passive	Active
Passive	Machine to Machine – M2M (autonomous-service)	Human to Machine – H2M (super-service)
Active	Human to Machine – H2M (self-service)	Human to Human – H2H (human-service)

3 The Evolution of Services Characteristics

This section discusses how *digital technologies* influence the *characteristics of services* (viz. intangibility, inventory (perishability), inseparability, inconsistency (variability), and involvement [5]) as a result of their *digitalization* in the above-mentioned service provider – customer interaction typology (see Tables 3 to 7).

3.1 Intangibility

Based on the service provider – customer interaction nature, determined by the role of *digital technologies* in the “service delivery process”, the *degree of intangibility* of a *service* can be classified as: “low, medium, or high”, depending on two main factors: (a) the presence of the human customer of the service in a service delivery process, and (b) the contribution of the digital technologies to give a sense of <tangibility> to the service itself. Hence, in the first interaction-type, human service provider to human customer (i.e. human-service), the service degree of intangibility is considered: “low”, because of a face-to-face and/or a virtual interaction takes place in real-time between the two parties involved, making the service delivery process more vivid, and therefore, more tangible. In the second and third interaction-types, the degree of intangibility is considered: “medium”, since in both types, being human customer to machine service provider (i.e. self-service), or human service provider to machine customer (i.e. super-service), a human-machine interface will permit a certain live-experience of the service delivery process for the human as a customer, or as a service provider, and a user

interface will allow a certain tangibility of the service itself. Lastly, in the fourth interaction-type, the service degree of intangibility is considered: “high”, due to an autonomous-service delivery process (i.e. autonomous-service) in a machine service provider to machine customer interaction, making the service delivery process completely intangible for the human as a customer, or as a service provider.

Table 3. Intangibility in Service Provider – Customer Interaction-Types

	Passive	Active
Passive	M2M (high intangibility in autonomous-services)	H2M (medium intangibility in super-services)
Active	H2M (medium intangibility in self-services)	H2H (low intangibility in human-services)

3.2 Inventory (perishability)

Based on a service physical or digital nature, its *capability* for being stored may change, and can be classified as: “low, medium, or high”. In this sense, a *physical service* cannot be stored, but a *digital service* can be in what computer scientists call a services library or a services directory. *Digital services* can be retrieved from digital storage, manually or automatically, for their (i) execution as they are, (ii) customization/configuration first and later execution, or (iii) composition with other digital services for the co-creation of a particular meta-service, or service bundles. Thus, in the first interaction-type, human service provider to human customer (i.e. human-service), a physical service cannot be stored due to its physical nature, and human delivery channel. Therefore, digital technologies can only facilitate the service delivery process, and as a result, its perishability level is considered: “high”. In the second interaction-type, human customer to machine service provider (i.e. self-service), a digital (standard) service can be stored in a service delivery device, and the human customer can consume it on-demand. So, digital technologies act as a service delivery channel, and the service perishability level is considered: “low” since we are referring to the consumption of a digital (standard) service. In the third interaction-type, human service provider to machine customer (i.e. super-service), a physical service or a digital (standard) service cannot be stored and/or consumed on-demand. Consequently, digital technologies can only help to make more efficient the delivery processes, since some level of customization/configuration may be needed before for the service delivery, and as a result, the perishability level is considered: “medium”. Lastly, in the fourth interaction-type, machine service provider to machine customer, digital (standard) services can be stored in an e-library or e-directory, so that digital technologies can create *autonomous-services* without human intervention as a customer or as a service provider, and as a result their perishability level is considered: “low”.

Table 4. Inventory (perishability) in Service Provider – Customer Interaction-Types

	Passive	Active
Passive	M2M (low perishability in autonomous-services)	H2M (medium perishability in super-services)
Active	H2M (low perishability in self-services)	H2H (high perishability in human-services)

3.3 Inseparability

Based also on the service provider – customer interaction nature, determined by the role of *digital technologies,* and their "automation capabilities", the *degree of inseparability* between the human service provider and the service delivery process can be classified as: "low, medium, or high". Hence, in the first interaction-type, human service provider to human customer, the degree of inseparability is considered: "high", since we are dealing with a *human-service.* In the second and third interaction-types, the degree of inseparability is considered: "medium", since in both cases, it would be possible to automate the human service provider role or the human customer role correspondingly, being the cases for *self-services* and *super-services.* Lastly, in the fourth interaction-type, the degree of inseparability is considered: "low", because we are referring to an *autonomous-service* delivery process that does not require human intervention in the role of a service provider or a customer.

Table 5. Inseparability in Service Provider – Customer Interaction-Types

	Passive	Active
Passive	M2M (low inseparability in autonomous-services)	H2M (medium inseparability in super-services)
Active	H2M (medium inseparability in self-services)	H2H (high inseparability in human-services)

3.4 Inconsistency (variability)

Based on a service physical or digital nature, its replicability and quality standardization in a service delivery process can be more or less easy to manage, so considering the complexity of its exact reproducibility, its *variability* level can be classified as: "low, medium, or high". Thus, in the first interaction-type, human service provider to human customer, the service has a physical and a *human-service* nature. Therefore, allowing high possibilities of service inconsistencies, since both service provider and customer are humans, and they could find difficult to reproduce exactly a previous service and its delivery experience, consequently, the service variability level is considered: "high". In the second interaction-type, human customer to machine service provider, service inconsistencies, in the context of *self-services,* have a tendency to be medium. Indeed, the human customer role is partially standardized by means of a <wizard> in the self-service user interface, and the machine service provider process is fully standardized in order to manage customer expectations. Consequently, the service variability level is considered: "medium-low". In the third interaction-type, human service provider to machine customer, service inconsistencies, in the context of *super-services,* also have a tendency to be medium, since the machine service provider aims for developing a catalogue of standard services or a service configurator in order to facilitate itself the delivery of different services as they are needed by the human customer. Thus, the service variability level is considered: "medium-high". Lastly, in the fourth interaction-type, machine service provider to machine customer, services inconsistencies tend to be very low, as the *automation* of a service delivery process requires the standardization of the service itself. Hence, service variability level is considered: "low".

Table 6. Inconsistency (variability) in Service Provider – Customer Interaction-Types

	Passive	Active
Passive	M2M (low variability in autonomous-services)	H2M (medium-high variability in super-services)
Active	H2M (medium-low variability in self-services)	H2H (high variability in human-services)

3.5 Involvement

Based also on the service provider – customer interaction nature, human involvement in the service creation and service delivery process can be classified as: "low, medium, or high". In the first interaction-type, human service provider to human customer, the *human* nature of the *service* makes essential the human involvement of both parties, hence, human involvement is considered: "high". In the second interaction-type, human customer to machine service provider, due to the *self-service* approach in the service delivery, only the human customer is needed, thus, human involvement is considered: "medium". In the third interaction-type, human service provider to machine customer, because of the *super-service* approach in the service delivery, only the human service provider is needed, therefore, human involvement is considered: "medium". Lastly, in the fourth interaction-type, machine service provider to machine customer, *autonomous-services* make human involvement unnecessary, and therefore, human involvement is considered: "low" or "null".

Table 7. Involvement in Service Provider – Customer Interaction-Types

	Passive	Active
Passive	M2M (low involvement in autonomous-service)	H2M (medium involvement in super-services)
Active	H2M (medium involvement in self-services)	H2H (high involvement in human-services)

4 Discussion

The level of usage of *digital technologies* in a *service delivery process* influences the *characteristics of services.* Such influence is in some cases is "positive" and, in others, "negative". For instance, as the level of usage of digital technologies increases in a service delivery process, the degree of *service intangibility* increases (see Sub-section 3.1), since the physical interaction between the human customer and the human service provider gets reduced. On the contrary, when it comes to the *service inseparability* (see Sub-section 3.3), the level of usage of digital technologies in a service delivery process decreases this characteristic, since technology makes possible to separate the customer from the service provider by using technology as an interface between them.

Furthermore, the influence exerted by the *digital technologies* in a *service delivery process,* and as a consequence on the *characteristics of a service,* is mediated by the type of interaction that is established between the customer and the service provider. For example, although *service inconsistency* (see Sub-section 3.4) decreases as digital technologies are used in a service delivery process, due to the process standardization,

it decreases more quickly in the case of *self-service solutions* because the process is directly controllable by the service provider to ensure its effectiveness.

Again, the influence of *services characteristics* resulting from the different levels of usage of digital technologies in the four types of *service provider – customer interactions* in turn impacts on the organisation and management of a *service delivery process.* Such impacts are briefly reported as follow: (i) When it comes to *service intangibility*, digital technologies increase this characteristic, and involve shifting the service physical evidence from humans (e.g. the technician uniform) to technology (e.g. computer interfaces); (ii) When it comes to *services inventory (perishability),* digital technologies can reduce the problems that traditionally affect the variability of services demand, including their design and availability management, as digital technologies can create "virtual buffers", and offer "elasticity" of digital resources (e.g. cloud ICT-infrastructures). However, particular attention must be paid to balancing the capability and capacity of a service delivery process; (iii) When it comes to the *inseparability* of the *service provider – customer,* the attention of the service provider shifts from being focused on the front-office activities (i.e. H2H) to the back-office activities (i.e. H2M), up to concentrating only on support activities when both customer and service provider are excluded from the service delivery process in a machine service provider to machine customer context (i.e. M2M); (iv) When it comes to *services inconsistency (variability),* its reduction in a service deliver process involves an increased "standardization" of overall service system (i.e. processes, competencies, and resource involved); and (v) When it comes to the *human service provider* and/or *human customer involvement,* the reduction of participation of humans in a service delivery process reduces the necessary efforts to make tangible "the intangible", because human customers are not interested in participating in the service delivery process, but they could still be interested in participating in the "service co-design [11]".

5 Conclusions and Further Research

This research work introduced a study aimed at understanding how *digital technologies* influence *services characteristics* in *service delivery processes.* To do so, it proposes a novel classification of *service provider – customer interactions* supported by digital technologies with two dimensions: (a) the presence and the role of the service provider in a service delivery process, and (b) the presence and the role of the customer of the service in a service delivery itself. The achieved results underline that digital technologies modify both the characteristics and delivery processes of services. Moreover, the degree of influence of digital technologies can be amplified and/or mitigated by the level of involvement of a customer and/or a service provider in a service delivery process. In other words, the planning and managing of the processes, competencies, and resources involved in a service delivery depends on the different types of service provider – customer interactions (viz. H2H, H2M, and M2M).

We believe that this work can have interesting managerial implications as it helps service managers and practitioners understand how to design/manage service delivery processes for different types of service provider – customer interactions. However, this research work presents some limitations. First, it is based exclusively on a theoretical

evaluation and a position that arises from the considerations of a group of researchers and practitioners[*]. Therefore, it would be necessary to deeply study the feasibility of the considerations that emerge when assessing whether services characteristics change in relation to the different types of service, customer, and industry. Moreover, empirical explorations should be carried out to analyse how different digital technologies impact on the different components of a service delivery process (viz. activities, resources, skills, infrastructure, measures) as well as to highlight their implications on the whole service lifecycle, from the interpretation of customer needs to the measurement of achieved results.

Further research should include the influence of *digital technologies* in *service quality determinants*, and in the structure of *service delivery processes* in reference to their *service blueprinting elements* (viz. customer actions, front-stage, back-stage, support processes, physical evidence, inventor, and line of visibility) [12].

6 References

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