AN EXPLORATIVE INVESTIGATION ON THE ROLE OF ECOSYSTEM RELATIONSHIPS IN MEDIUM-SIZED MANUFACTURERS DIGITAL SERVITIZATION

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ABSTRACT

Purpose: IoT technologies (IoT, Cloud, Data analysis, Big data) have an increasing role for service-led growth, and in particular for enabling BtoB advanced solutions. This paper analyses interfirm relations taking place in digital servitization (DS).

Design/Methodology/Approach: The study draws on qualitative empirical research regarding medium- to medium-large sized Italian firms driven Digital Servitization projects. Seven DS projects focalized around medium-large BtoB manufacturers are considered in the analysis.

Findings: Empirical data shows that inter-organizational relationships play a critical importance for the survival and success of DS projects, highlighting different ideal-typic relational settings with different relational structures, challenges and strategic evolutions.

Originality/Value:

The paper makes theoretical and managerial relevant contributions in the field of inter-organizational solutions adopted in DS by medium manufacturers. A strategic map helping managers to navigate digital servitization projects in relation to internal and external contributions and alignment strategies is provided.

KEYWORDS: Digital servitization; ecosystems; Medium-sized firms.

1. INTRODUCTION

The paper analyses the role of service ecosystems' in digital servitization (DS). A service ecosystem relational perspective is adopted in the study, with the aim of investigating roles, strategies and dynamics of multi-actor contributions, also highlighting specific relevance and relational activation modes in DS. The empirical focus is on an under-investigated dimensional category of firms, namely medium-sized companies, a particularly dynamic category within manufacturing firms. The research question this paper aims at answering is: what is the contribution of inter-organizational relationships to DS in medium-sized manufacturing firms?

2. THEORETICAL BACKGROUND

IoT technologies (IoT, Cloud, Data analysis, Big data) allow new advanced BtoB services, digital Product-Service Systems (PSS), and business models (BM), enabling digital servitization (Paiola and Gebauer, 2020; Pirola et al., 2020; Paschou et al., 2020). Technological and managerial evolution affects different aspects of contemporary servitization research (Kowalkowski et al. 2017), unveiling the urgency of considering the increasing relevance of the ecosystem perspective (Sklyar et al., 2019) and systemic value designs (Leminen et al., 2020). This entails a revisitation of the servitization narrative (Baines et al., 2017) that: considers the importance of collaboration (Tronvoll et al., 2020); extends the focal manufacturer perspective with a multi-actor capabilities approach (Story et al., 2017); and integrates key customers contributions (Grandinetti et al., 2020). Notwithstanding the mentioned contributions, literature has so far overlooked to dedicate a specific research effort to understand modern technology-based service development strategies in medium-sized BtoB manufacturing firms (Sjödin et al., 2020).

Digital servitization is a complex effort for manufacturers that ask for disruptive changes in their business models (Kohtamäki et al., 2019). Different elements of the firms' BM are involved in DS transformations, from value creation (capabilities), to value distribution (market segmentation, customer relations and trade channels), to revenue and profit mechanisms (cost and revenue impacts). In this framework, the value proposition is a central element in business model innovation, being the central element that connects different BM blocks.

Digital servitization impose incumbent manufacturers to modify their value proposition, offering new data-based product-, process- and customer-oriented services (Paiola and Gebauer, 2020). These can have different impacts on firms' BM, from simply lowering the cost of traditional product-service related services, to enriching products and services with unprecedented features (for availability and remote controlling), to radically changing the revenue model by enabling completely new relations with the market. This can enable the transformation of the value proposition towards use- or output-based types (Adrodegari et al., 2015).

DS can leverage internal resources, existing inter-organizational relationships, and newly formed partnerships. Previous studies have highlighted the role of relational embeddedness in service ecosystems (Sklyar et al., 2019), referring to the impact on economic outcomes of the socially-rooted overall participating actors' relational structure and dynamics (Granovetter, 1992). Relational embeddedness can be related both to internal and external actors involved in service ecosystems: internal relational embeddedness influences the manufacturer to access and combine resources from corporate counterparts and sustain internal learning processes (Forsgren et al., 2005). Little intra-organizational embeddedness is only one of the circumstances that bring medium-sized manufacturing firms to turn to external actors to initiate and sustain DS.

2.1 Towards Digital Servitization Ecosystems?

While driving successful DS projects with internal resources may be fit to large multinational enterprises, minor manufacturing firms may have different ways of approaching DS, due to a series of limitations related to their slack resources; their internal capabilities, especially in regard to digital technologies; and their traditional manufacturing culture and low familiarity with advanced service logics (Paiola and Gebauer, 2020; Peillon and Dubruc, 2019).

In this scenario, external contributions can play a crucial role for medium-sized manufacturers in order to approach the complex and new capability-related challenges related to digitalization and servitization (Parida and Wincent, 2019). New specific external relationships may have to be established in order to start and/or sustain the evolution of new digital services in the offering, leading to the formation of Digital Servitization Ecosystems (DSE), that is dedicated networks of firms that are specifically aimed at DS business models.

Inter-organizational contributions may have the form of dyadic relationships (Raddats et al., 2017), multi-actor relationships (Story et al., 2017), or ecosystems of multi-actor coupling engaged in reciprocal value proposition (Tronvoll et al., 2020). Defining the ecosystem as the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize, we refer to Adner's (2017) definition of "ecosystem as structure" for describing the relational networks involved in DS. In these ecosystems a focal value proposition, belonging to a focal firm's BM, has a pivotal role in the network construction and directly affects its boundaries and its future geometry. Members of the ecosystem include stakeholders like manufacturers, suppliers, and customers, whose capabilities and roles tend to coevolve and to align themselves with a focal leader, that enables members to share visions, to align their strategies and investments, and to find mutually supportive roles (Moore, 1996), and eventually create a reciprocal value proposition (Tronvoll et al., 2020).

Ecosystems evolve overtime in a continuous search for value (Oskam et al., 2020): this means a constant need of alignment of temporarily agreed upon structures of position and flows, complying with the different actors' changing aims and end goals (Adner, 2020). Partner alignment is assessed relative to the focal firm's ability to bring its partners into the positions and roles that its ecosystem strategy envisions. Given the potentially disruptive nature of DS, the effect of learning processes and the consolidation and maturation of value propositions, DSEs are expected to evolve accordingly, with a frequent need of alignment in order to overcome collaboration barriers (Gebauer et al., 2020). Defined set of partners may vary overtime, following different balances in joint value creation and ecosystem traits can be or can become latent overtime whenever ecosystem's partners dynamic alignment ceases to represent an issue.

3. RESEARCH METHODOLOGY

The study draws on in-depth face-to-face multiple interviews with different informants belonging to incumbent Italian manufacturing firms involved in DS. Specifically, the research focuses on DSE created around DS projects held by medium-sized manufacturing companies, a particularly innovative and dynamic firm category in Italy. The firms are leading industrial firms, located in the North of Italy (in particular: Veneto, Emilia Romagna, and Lombardy), belonging to dynamic and world-renowned Italian industries, like packaging machines, professional cooking, commercial refrigeration.

Given the explorative approach, our empirical setting favoured theory-building considerations over statistical sampling, selecting cases for their relevance for our research questions, their contribution to represent conceptual variety, and their convenient accessibility and proximity to the researcher. Sampling process ceased at theoretical saturation, as indicated by information redundancy (Silverman, 2005). In-depth interviews were conducted with relevant informants belonging to the most relevant components of the DSEs, between September 2020 to March 2021. Interviews were registered, transcribed and coded following scientific qualitative protocols (Voss et al., 2002)

3.1 Case selection and description

We analysed seven ecosystems specifically related to ongoing DS projects that started between 2014 and 2016. These innovation projects involve various manufacturers using IoT, Cloud and Data analysis technologies in order to craft new service-oriented value propositions. The solutions envisioned vary from RCM platforms able to increase visibility and reporting of production processes, to performance-based contracts linked to agreed-upon service levels with bonus-malus mechanisms. The value proposition is designed around availability-, energy-, or performance-oriented data-based service innovation. Ecosystems are crafted around an emerging digitally based value proposition by a Focal Firm (FF). Our Digital Servitization Ecosystems (DSE) are composed of 7 to 10 relevant actors, actively participating in the design and deployment of the DS. Table 1 shows basic features of the DS projects and focal firms involved in the research (see appendix 1 for ecosystem actors' details).

Table 1. Basic features of DSEs

Case	Starting year	Type of PSS	Value proposition and Revenue model	Industry (FF)	# of firms involved
1	2015	RCM platform, visualization and reporting, ML applications	Energy efficiency-related; Subscription	Commercial refrigeration	10
2	2016	RCM platform, visualization and reporting, cloud based services	Availability-related; Subscription	Packaging machines	8
3	2016	RCM platform, visualization and reporting, integration with CRM omnichannel, cloud based services	Availability-related; Subscription	Professional cooking	7
4	2015	RCM platform, visualization and reporting, cloud based services	Availability-related; Subscription	Water processing equipment	9
5	2014	RCM platform, BI and reporting (suite in 5 separate modules)	Availability-related; Within product	Raw material processing machines	7
6	2014	RCM for Customized PBC, visualization and reporting, , cloud based services.	Performance-based; subscription	Packaging machines	8
7	2015	Digital environment for helping customers to develop digital RCM and reporting solutions; ML applications for industry benchmarking	Availability-related; Within product	Commercial refrigeration	8

4. FINDINGS

The research reports the main organizational and strategic choices firms have made regarding variables relevant in this research, such as relations construction and management, capability development and acquisition, solution development and replication, highlighting challenges and opportunities.

Findings show that DS produce a significant networking activity that involves internal divisions and external firms, in search of the useful capabilities for DS. Internal divisions promoting the change may vary from R&D to Service dep.t to IT dep.t, and the ownership may vary overtime. Internal teams dedicated to DS may vary amply from 2 to over 10 depending on the type of value proposition and service envisioned. Intra-organizational embeddedness of the promoting BU may vary substantially, especially at the corporate level (some of the firms are independent firms belonging to diversified groups): however, it has to be noticed that C-level managers seem not to be the main promoters of the innovation, even if their support is fundamental for the project to grow.

The actual leverage of internal resources is extremely variable and our cases show examples of fully internal management to full externalization of initial and consequent DS activities, depending on the availability of internal capabilities for the project (quality and quantity) and the level of intra-firm structural embeddedness. The extent and embeddedness of inter-organizational networks can vary significantly. External relationships can involve a differentiated array of technology related firms, such as global suppliers (cloud services, ERP/CRM systems, IOT platforms, TLC companies), their local partners, local or national KIBS (HW devices designers and producers, system integrators, software houses, start-ups, individual ICT consultants), Universities and Research Centres. Specific actors of the service ecosystem are searched for and involved in the project on the initiative of the focal firm's basing on the desired value proposition, and these relations feed back into value proposition evolution. In particular, relations with global technological suppliers, their third parties, or other software and hardware related companies (KIBS) have a significant role in shaping the present and future architecture of the envisioned solutions.

Customers, especially lead users and key clients, impact the inception and development of DS projects, where the technology-based solution envisioned by the supplier is in fact the result of an intense and deep operational co-creation with the key-customer, that involves a profound and ongoing transformation of supplier-customer relations.

Table 2. The evolution of the DSEs

Case	Evolutionary features from the FF point of view
1	Internalize core software activities and open new advanced specific collaborations for data
2	Local third parties are substituted by internal team, with direct relations with the technology supplier; the team/BU is relocated in a new staff position for the corporate
3	Balance extant and new relationships. Internalization of critical capabilities through hiring and organic growth
4	Empowerment of internal IoT team with capabilities related to UX/UI and sales BD; better involvement of the R&D division; increase internal orchestration of external contributions
5	Internalization and specialization of software activities with horizontal coordination; incorporate data-driven mechanisms and create service propositions
6	Internalization of architectural and value-related competences, direct access to the code and orchestration of different types of contributions (from generic to specific)
7	Internal control and leverage of existing relationships on a project-based logic

The fundamental element of the ecosystem is the focal firm (FF), or the manufacturer that promotes the use of technology for innovating its value proposition. The centrality of the manufacturer's business model affects two relevant aspects of the ecosystems: the type of relations and their evolution. As regards the type of relations, FFs tend to prefer managing direct dyadic relations with relevant external actors, like technology suppliers, service providers and selected key customers. External integration of sub-networks is relatively more frequent in the first phases of the projects.

In addition, data show that relational approaches change overtime in the selected firms, following the evolution of the firms' offering as regards digital services - especially concerning the transition from prototypical and replicable versions - and the changes in the BM. As shown in table 2, all the FFs are using external collaboration in order to foster co-learning in the new knowledge domain, aiming at progressively internalizing core activities (above all software architecture design and integration capabilities) and orchestrate external competences that require massive code writing, or related to specialistic knowledge (e.g. UX/UI or more recently, ML data analysis algorithms). Having the access to the source code is mandatory in all cases.

5. DISCUSSIONS AND CONCLUSIONS

Findings show that, although the ecosystem approach is a valuable theoretical perspective also for investigating DS in smaller firms, not all the innovative projects may be considered within the ecosystem perspective. In fact, while some cases are perfectly reflecting the "ecosystem as structure" concept (Adner, 2017), altogether a more fragmented and differentiated discourse has to be made.

As figure 1 shows, DS is at the base of four different approaches to internal- vs. external-contribution management, resuming different situations from dyadic to multi-actor ecosystems (Raddats et al., 2017; Story et al., 2017; Tronvoll et al., 2020). Using the level of openness to external contributions and the level of relational innovation connected to DS, we distinguish the cases of: Organic transformation, Extant relationships leverage, New Business Unit and New ecosystem.

Firms adopt one of the above mentioned approach depending on different contingent circumstances, such as: prior knowledge related to the required software and hardware components of the digital solutions; the availability and extent of useful internal capabilities; the extent of available financial resources; the commitment in the new value proposition; the reaction to external solicitations from customers and technological partners.

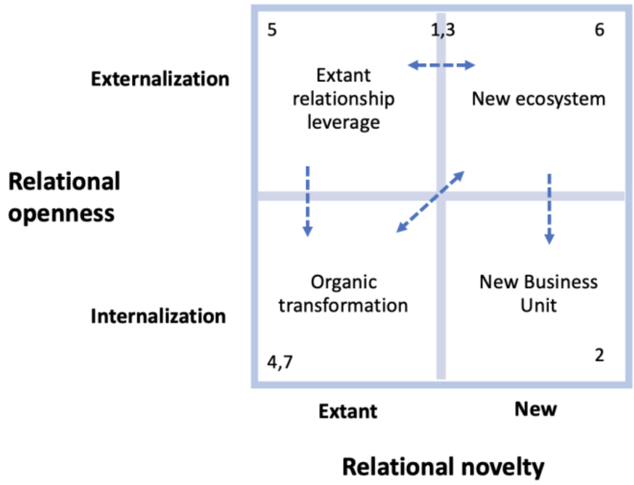

Figure 1: A map of ecosystems governance: openness and novelty in relations

Depending on the approach, DS may lead to an almost independent organic transformation by the focal firm, that prevalently manages all the activities at an internal level with project-based relations to external actors for specific subjects (cases 4 and 7); the construction of an entirely new Business Unit, built with an initial effort with external actors then internalized with specific hiring (case 2); the prevalent leverage of pre-existent external relationships that are in different ways involved in the new project, depending on their capabilities (case 5); the creation of an ecosystem where participants are prevalently new to each other (new ecosystem, case 6); the extension of extant inter-organizational networks with new participants (cases 1 and 3). The approaches are evidently differing in terms of challenges due to ecosystems' novelty and in particular evidencing: strategic alignment for new relationships, lock-in effects for extant resources; lead time and SLAs for external contributions and knowledge update investments for internalized solutions.

Some evolutionary elements also emerge from the cases, showing that inter-organizational choices are strictly connected to the evolution of the value proposition and the diffusion of the offering in the market. At this regard, we register three main transitional changes in the examined firms: co-learning and co-evolution (in the case of partnering the solution expenses with the supplier) processes, present in all the cases with significant external participation in the founding stages of DS; progressive internalization of core capabilities, and relational simplification from multilateral to dyadic, with orchestration of external specialized firms in the cases of firms starting with higher inter-organizational propensity (that may lead to an organic development or to a new BU); an overall cyclical shift in the balance between internal and external, extant and new contributions depending on the evolution stages of the project (for all the approaches).

5.1 Implications and limitations

From a theoretical perspective, the research confirms some previous evidence and offers some advancements. First, DS is particularly challenging for medium-sized firms, due to ongoing technological exploration, dynamic strategic processes, and complex intra- and inter-organizational networks. Second, DS strategies may be designed within specific relationships, where original co-evolution processes are in place. Third, empirical evidence indicates that inter-organizational relationships and ecosystems structures depend on the value proposition evolution, and we highlight three transitional processes taking place in DS in our firms. Finally, medium-sized manufacturing firms indeed deserve a specific attention, facing peculiar technology- and market- related challenges and opportunities, and evidencing inherent balances and different transformational shifts between hierarchy and partnership (Tronvoll et al., 2020).

From the managerial point of view, our cases show that a series of different contingent approaches apply to medium-large manufacturing firms in order to start and develop DS. Each approach has advantages and challenges and may fit contingent firm's conditions. However, considerations may change depending on the stage of the transformation process, asking for a dynamic modulation of openness and closeness in light of what competence may become relevant for different stages of the DS transformation journey. Customers, especially lead users and key clients, can represent relevant ecosystem's actors whose role is particularly significant for piloting and solution debugging. A progressive increase in the manufacturer's ability in selecting and orchestrating external partners as the new value proposition establishes indicates a learning process that allows the firms to focalize their position and align the ecosystem partners. A risk of being trapped in a sub-optimal technological lock-in are present for the more autonomous firms (in particular for the organic transformation case).

Main limitation of the study pertain to the restricted number of cases, that could be extended by enlarging the sample, and the need for better codifying the specific conditions that affect firms' DS inter-organizational strategies (e.g., prior related knowledge), as well as the specific elements affecting their evolution.

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APPENDICIES

Appendix 1: DSE's firms involved in the research.

Cases	Actors	Facts (2020)	Relation with FF: features	Relation within ecosystem
1	Focal Firm	medium large co. Commercial refrigeration equipment		
	Internal main promoter of innovations	Service division and IT division; 3 technicians, 2 managers; 22 FS technicians; head of IT (main technology manager, signs contracts)		
	Cloud technology provider	VL MNE	Starting 2020	
	Cloud provider local partner	50 people, team 4 people for FF	Direct relation, starts 2020 specifically for data analysis	Relation with local software firm for integration with ERP.
	Local software firm (historical captive firm)	10 people, interfunctional	Direct relation; historical captive partner (2007), for custom vertical ERP, post sale service management	Technical coordination with 4; limited competition with others (coopetition)
	Datacenter and ICT services	3 people	Historical captive partner (2000s), for datacenter and telemonitoring	Few relations; interacts with local software firm
	local web service related firm	SME Kibs	direct, spot	none
	Specialized in data analysis	SME Kibs	direct, spot	none
	Freelance consultant	Individual IT consultant	Historical (captive) consultant for IT related subjects, continuous	Operate in staff with FF's IT manager
	Key customer	VLE	direct, continuous, lead user	none
2	Focal Firm	SME, packaging machines		
	Internal main promoter of DS	digital services division; 4 people software, 1 BD		
	FF corporate company	VLE, packaging machines	Limited (for the DS)	none
	Local IoT SW provider III party (dismissed)	VL MNE	Initially unique interlocutor (then disintermediated)	no relations
	IoT-related software technology provider	VL MNE	Initially no relation (mediated by local party); then direct	no relations
	Spin off for data related services	Small start up	Mission of coordinating and orchestrating different corporate digital projects	few
	Cloud technology provider	VL MNE	direct	no relations
	Key customer	VL MNE	direct, piloting	no relations
3	Focal Firm	LE, professional cooking equipment		
	Internal main promoter of DS	IT division (CEO mandate), 10 people dedicated; IoT part developed internally		
	Cloud technology local III party	30 people (the firm is part of a larger ICT group)	Counseling on technological selection	Orchestrate other external contributions; coopetition.
	Cloud data analysis technology provider	VL MNE	indirect and direct	With cloud local partner
	Data analysis and visualization SW firm	SME, Kibs	direct, project based: starts 2018, ends 2020	none
	ERP technology provider	VL MNE	indirect	with ERP local partner
	ERP provider partner	SME, Kibs	direct	with ERP provider
	Cloud service provider	VL MNE	direct	none
4	Focal Firm	LE, water processing equipment		
	Internal main promoter of DS	R&D manager original promoter; new IOT and connectivity division in 2019, 10 people		
	Corporate company	VL MNE, water pumps	direct, collaboration	none
	University accelerator	SME	direct	none
	University spin off start up for digital agile processes and UX consultancy	SME, Kibs	direct, starts 2020 for UX	none
	ERP and BI technology provider	VL MNE	direct and indirect	with local SW consultant
	Local SW consultants	SMEs	direct	none
	Cloud technology provider	VL MNE	direct	none
	Key customer	External Service network, SMEs	direct	none
5	Focal firm (corporate)	LE, Raw material processing machines		
	Internal division involved in DS	Overall R&D involved and specific division for DS production; 100 people (45 for software in 8 teams); 8 people for the DPSS		
	Industry-vertical platform developer	M	Direct, specific vertical aspects	none
	Technological system integrator	150 people; 2 people for FF; partner MS and Wonderware; historical partner	Direct; parnership 50% ownership of the software (non-competitive)	with alle the three following actors
	External SW consultants	SMEs	collaboration / codesign, specific tasks and activities not covered internally	with the system integrator
	Process related technology provider	VL MNE	Collaboration for the design of the suite	with the system integrator
	Key customers	Usa and Corea: pilot customers	direct	with the system integrator
6	Focal Firm	SME, packaging machinery		
	Internal division involved in DS production	4 people; 10 on premises		
	Corporate company	LE, packaging machinery		
	IoT-related software technology provider	VL MNE	indirect (then dismissed)	with the local partner
	Local IoT-related software technology provider partner	40 people; 4 inteam for FF	direct, daily	with IoT tecnhlogy provider
	Local ERP and software partner (dismissed in 2015)	LE	direct, daily (dismissed in 2016)	none
	Cloud technology provider	VL MNE	direct	none
	Local software firm provider	LE, divisional	direct (dismissed)	none
	Local data and UX service provider	4 people	direct, started 2020	none
7	Focal Firm	LE		
	Internal division involved in DPSS production	R&D, specific team 5 people for IOT-based services;		
	Data analysis and visualization SW firm	SME, Kibs	direct, project based	none
	Local University research center	2019, then interrupted	project based	none
	Specific telemonitoring HW and SW BU	group firm, 2005-2011 (ceased)	direct	none
	TLC company	VL MNE (still present but dismissing)	project based	none
	Cloud technology provider	VL MNE	technological supplier, extant	none
	Visualization platform technology provider	VL MNE	technological supplier, extant	none