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Public Administration, Technology and Administrative Capacity

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Abstract

Technology is clearly a critical factor in the lives of organizations, yet there are only few studies that deal with technology and public organizations. In this paper we propose to understand technological change in public sector, in particular how technology influences administrative capacity, through the new concept of technological capacity. We use the case of Estonia – internationally associated with a strong e-state profile – as an exploratory case to answer two research questions: how does technological change influence administrative capacity in public organizations, and why and how does technological change take place in the public sector. By conducting document analysis and a series of interviews with public sector representatives, we demonstrate how dynamic and static change in technological capacities is influenced by four different public-sector feedback and selection mechanisms. Organizations with dynamic technological capacities solve the ambidexterity dilemma in the public sector: they introduce radical new technological solutions while they keep providing services required by laws and regulations. We conclude that in spite of the neglected position of technology in public administration literature, technology is an intrinsic factor in how administrative capacity evolves.

Keywords: technological capacity; evolution; feedback; selection; public sector change; Estonia

Introduction

Technology is clearly a critical factor in the lives of organizations. We know from private-sector research how companies have changed their work organization due to different technologies (see Perez 2002 for a historical overview) and especially more recently ICT (e.g. flat hierarchies, platform-based services, peer production) (Trist 1981, Barley 1990, Leonardi and Barley 2010, Bloom et al. 2009). There is increasing pressure for the public sector to do the same – arguably public sector innovation (Osborne and Brown 2013), e-government (Janssen and Estevez 2013) and smart-city discourses (Townsend 2013) reflect such pressures. And while there is a long-term tradition in researching how technological changes impact work organization in companies, there seems to be little evidence from public organizations (Margetts and Dunleavy 2013; Pollitt 2012).

In this paper we propose a novel framework to document and understand technological change in the public sector. Although much has been writ-

ten about what kind of technological change public sector organizations should undergo in order to increase the efficiency and effectiveness of public service delivery (e.g. Brown et al. 2014), little is known what dynamics make this possible in the public sector.[1] We propose to analyze the technological impact on public sector performance through the new concept of technological capacity. In our view technological capacities are an increasingly critical element of administrative capacity. Thus, we develop further the existing concept of administrative capacity, and as there are hardly any studies on technology and public organizations, we start from the micro-level and build the framework from the bottom up (while the next studies could also look at the state and especially policy capacity).[2] By administrative capacity we understand the delivery of tasks within a given framework of resources (human, financial, relational) and authority (reputation, coordination practices, politics) (see also Painter and Pierre 2005). We define technological capacity as an ability to explore, develop and/or adapt new technological solutions in public service design, delivery and evaluation; we argue that technological capacity is formed through co-evolutionary selection and feedback processes between public organizations, markets, policy networks and citizens.

In this context the article will tackle two inter-related research questions. First, how does technological change influence administrative capacity in public organizations? What happens within public organizations when they adopt or develop new technologies? Second, why and how does technological change take place in public sector? To put it simply: why do some organization adopt or develop new solutions and others do not; why are some organizations able to be ambidextrous and others are not? To our knowledge these questions have not been sufficiently studied in PA literature.

When it comes to technology and public administration, Estonia can be considered an exploratory case to study. Estonia in general has been associated internationally with a strong e-state profile, and recently the country has been trying to take lead in cybersecurity norms (Crandall and Allan 2015). Famous for its e-government developments, particularly the electronic ID card and the secure data-exchange architecture (the so-called X-Road[3]) beneath it, Estonia has successfully launched one of the leading solutions of its kind globally. Near universal diffusion of the ID

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1 Important debates about the so-called Baumol's disease are part of these discussions but we will not include these here due to space limitations. See Baumol 1967, more recently Gallouj and Savona 2010; Bailey et al. 2016.

2 Van de Ven and Poole (1995) provide good arguments for this kind of approach in organizational studies.

3 See for details: https://e-estonia.com/component/x-road/.

card among the citizens has led to the fact that almost all personal income taxes are declared and medical prescriptions are issued electronically, with other e-services covering a wide range of areas (central and local government offers some 1000+ services fully on-line). More recently, the government of Estonia launched an ambitious e-residency program aiming at attracting through public service exports some 10 million new e-residents globally (Estonia has 1.3 million actual residents). The government also proposes to partner up with Uber to use the Estonian e-government infrastructure to fully automate the tax declaration process for Uber drivers globally.[4] At the same time, Estonia is also internationally known for its exceptionally high social trust towards e-government solutions, where privacy-related issues have very little impact on policy debates. In addition, the last decade of public sector reforms has been implemented under radical austerity conditions (Randma-Liiv and Kickert 2016, Kattel and Raudla 2013) that could provide a strong impetus for technology-intensive reforms.

Consequently, we test the proposed conceptual framework with nine case studies from Estonia: postal service, emergency medical service, public-transportation services, welfare services, social-insurance services, employment services, tax-collection service, internal-security services and e-residency. The selected cases reflect both core public sector tasks and emerging public services. We aim to show that in each case, new technological solutions impacted how administrative capacities evolved in the organizations responsible for these developments and how their technological capacity evolved. In conclusion, we discuss new research agendas for public administration and policy scholars in relation with technological change.

The first section of the article outlines the main conceptual issues with technology and public sector change as well as introducing the concept of technological capacities. The second section provides an overview of the selected case studies. The final section concludes the paper by discussing the main implications from the study.

Theoretical discussions: Technological capacity of the public sector

Complex and sophisticated technologies (from medical technologies to predictive policing) have clearly changed what kind of services public sector organizations can deliver, but often the benefits or added value from

4 See for details: http://www.emta.ee/eng/etcb-and-uber-collaborate-seeking-solutions-development-sharing-economy.

employing these technologies are very difficult to account for in traditional organizational productivity calculation (for a recent wider discussion on public sector productivity, see Hood and Dixon 2015). For example, increased life-expectancy, reduced crime-rates, shortened service-delivery time, increased legitimacy or trust of governments and similar positive added public values are simply very difficult to link to the technological performance of a particular public organization. In other words, an important gap in our theoretical understanding of technology in the public sector relates to linkages between introducing new technological solutions and performance. In order to go beyond efficiency/productivity calculation, which is bound to remain handicapped in this context (see already Baumol 1967), we propose to conceptualize technology capacities in the public sector.

In order to capture technological capacities of public sector organizations, and their impact, we need to understand what mechanisms drive the speed, sophistication and direction of technological developments in the public sector. Technology changes the role of bureaucracy and work organization in many ways. This process is, however, not entirely deterministic, that is technological advances do not come with blueprints for how organizations should or will adapt them. Studies on the organizational level have shown that technologies are capable of shaping not only actions and social structures (e.g. cloud computing and real-time monitoring make organizations more flat), but also how organizations and groups within organizations tend to appropriate and shape technologies to reproduce existing social structures and organizations (see Orlikowsky 1992). This is, for example, also clearly seen in contemporary e-government literature, where a major concern is that the public sector has so far mostly been able to digitize its existing routines and practices and only seldom managed to profoundly rearrange its work organization (see, e.g., Brown et al. 2014). In a recent literature review Leonardi and Barley conclude that:

> Our review makes clear that students of technology and organizing agree on a fundamental ontological point: technologies do not directly determine organizational structures and dynamics. Instead, the changes that technologies occasion are intimately tied to social dynamics that are likely to vary across contexts (2010, 30).

Thus, social context determines technologies and vice versa, making co-evolutionary change central to the concept of technological capacity. In order to understand these co-evolutionary processes, we can look at how evolutionary economics conceptualizes innovation. In this tradition, innovation is foremost an organizational process (Coriat and Weinstein 2002),

where organizations, their routines and capabilities co-evolve with technology (Nelson and Winter 1982) while being influenced by the wider institutional context (i.e. innovation systems, Lundvall 2010). Organizational routines (i.e. regular and persistent operating procedures) determine the ability of an organization to undertake and master specific (novel) tasks (Teece 2009).[5] Importantly, these routines are sticky and path-dependent, but not static as they change over time. The evolution of routines in organizations is on the one hand related to internal search capabilities and on the other to a specific selection and feedback environment that all influence how organizations learn and make choices (ibid.; also March 1991). In other words, the organizational choice is never fully autonomous (Coriat and Weinstein 2002) – the evolution of underlining technological capacities of organizations does not depend only on internal structures and processes of organizations, but also on that of key partners and how these networks are structured by rules and regulations.

To summarize, first, capacities are best expressed and studied through routines; and second, there are three key elements that one needs to take into account when conceptualizing the evolution of technological capacities as routines in the public sector: internal routines, external routines and selection and feedback environments. Internal routines reflect a mix of public sector organizational standard procedures from procurement to implementation practices, while external routines reflect that of key partners. These internal and external technological capacities are intrinsic to the process of technology development and by and large determine what new technologies a public sector organization can initiate, take up and sustain. As indicated, these technological capacities evolve by having an impact on the external environment that operates as selection and feedback mechanisms (re-enforcing or discouraging specific routines). The selection and feedback mechanisms are, thus, extrinsic to the process of technological development. They re-enforce what the organization has already learned and, through the organizational level depositories of knowledge, guide future learning processes both on the individual and organizational levels (Crossan et al. 1999). In the public sector context one can distinguish between four selection environments: citizen-feedback processes, market processes, policy-network processes and hierarchical politico-administrative processes. Table 1 summarizes the presented framework.

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5 Importantly, Teece and others essentially juxtapose dynamic capabilities and organizational routines; we follow here Nelson and Winter 1982 and Zollo and Winter 2002 in assuming that dynamic capabilities are part of organizational routines.

Table 1: Technological routines and selection mechanisms in the public sector

	Selection mechanisms through:			
Technological change is affected and affects:	**Citizens**	**Market type behavior**	**Networks**	**Hierarchical behavior**
Internal technological routines	E.g. citizens' expectations and needs may change due to technology	E.g. procurement practices can influence the nature of competition and technological advancement	E.g. access to policy design might be conditioned by internal routines	E.g. use of predictive mobility models might enable better policing and/or increase organizational productivity and/or change organizational structures
External technological routines	E.g. citizens' technological skills may affect government legitimacy	E.g. monopolistic skills might drive prices for new solutions very high (healthcare e.g.)	E.g. skills of partners, expectations might change policy contents	E.g. state audit's evaluation models might deem the above policing model too expensive

Source: authors.

In order to simplify how technological capacities of the public sector (internal technological routines) evolve, we propose to analyze them on a (more/less) dynamic-static continuum. Thus, dynamic technological capacities are expressed through fundamental and rapid changes to existing administrative capacities in a particular organization (usually assuming a cumulative change in structure, division of tasks, management, power relations etc.); static technological capacities are in turn expressed through relatively unchanged administrative capacities leading to a continuation of existing evolutionary trajectories (sometimes called "digitization of existing routines", where core organizational tasks remain unchanged, but there is a new digital layer developed beyond what an organization does already). Some organizations are neither dynamic nor static, and some departments within static organizations can be dynamic, and vice versa. Importantly, organizations with dynamic technological capacities manage to solve March's dilemma of exploring and exploiting, or what could also be called the ambidexterity dilemma in the public sector: how to introduce radical new technological solutions while providing for services prescribed by laws and regulations (March 1991; O'Reilly and Tushman 2008; Helfat and Martin 2015).

Further, these selection environments exist in parallel in a co-evolutionary manner; that is, they influence each other and vary in their importance vis-à-vis specific public sector activity. In cases where impacts of public

sector performance are difficult to measure by universally accepted means, the feedback depends heavily on stake-holders' value-based perceptions (e.g. seeing individual or collective gains) as well as on political, ideological or cognitive frameworks that these stakeholders apply when confronting or applying technologies. One can argue that in these cases the feedback on public sector performance is almost always (politically) mediated, whereas in some other cases where the impact is easy to measure and communicate the feedback tends to be more direct in its nature (e.g. if fiscal profit/loss or user participation can be effectively used as indicators).

Importantly, different selection environments can be in conflict with each other. For instance, the increased big data and monitoring capacity of a public sector organization may lead to more efficient and effective public services (e.g. policing, transportation) – change in internal technological routines. It may create positive market spill-overs – change in external technological routines –, but it may also evoke strong skepticism among some partners on the basis of excessive surveillance and lead to outright protests towards the government. Yet, there are also other important considerations to be taken into account. For example, autonomy of an organization to deviate from and indeed challenge the existing characteristics of wider institutional settings is important (Coriat and Weinstein 2002; Tõnurist et al. 2015). As institutional settings can both constrain and provide resources and opportunities for organizations, the variety generation in society happens when organizations using different systems of rules come into conflict with other systems of rules, which eventually may lead to the de-legitimization of old norms and institutionalization of new rules (Coriat and Weinstein 2002). This means that both the relative importance of different feedback environments and interaction patterns between internal and external stakeholders can change as a result of conflicts between actors' use of the rules of the game.[6]

We can formulate several theoretical expectations based on the discussion above – these are presented in Table 2 below.

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6 Of course, there are many other possible intervening factors to public-sector change, such as the overall administrative culture, public-sector reform ideas etc. (Pollitt and Bouckaert 2011), but these can be seen as part of the market, hierarchy, network or citizen relationships. Overall, our point here is to understand the role of technology in public-sector change and not to describe all the factors individually.

Table 2: Theoretical expectations

1. Citizens' feedback:	**a)** Rapid diffusion country-wide e-infrastructure and e-services (e.g. electronic banking) lowers the barriers of entry for new public e-services and technological solutions. If this is the case, we can expect citizens to be open to new solutions.
	b) Privacy concerns among citizens functions as a key selection mechanism in the evolutionary process of public sector technological solutions. We expect rapid technological change in public organizations where privacy concerns have little impact.
2. Market feedback:	**a)** Public organizations are tasked with delivery of universal services and accordingly focus on – to use terms coined by March (1991) – exploiting existing technological solutions rather than experimenting with new ones. As most of the technological solutions in public sector are insourced from private sector, we can expect thus external technological routines to be key selection mechanisms of technological change in public organizations.
	b) We expect to see slow rate of technological change where market capabilities are fragmented.
	c) We expect to see rapid rate of technological change where public procurement leads to the creation of new private niche markets or similar positive economic spillovers.
3. Network feedback:	**a)** Public policies are always carried out in a wider institutional context where various policy stakeholders influence both policy choices as well as implementation. Thus, we expect stakeholder engagement practices to have significant influence over technological change in public sector.
	b) Relatedly, we expect the degree of political power these stakeholders have in policy networks to influence the evolution of technological capacities in public sector depending if the dominant stakeholders possess high or low level technological routines.
4. Hierarchical feedback:	**a)** In the decade-long austerity context, we can expect that austerity politics plays important role in driving technological solutions as they are seen by political and business elites to potentially boost productivity in public sector and enable emerging countries' quests to become global leaders in e-government solutions.
	b) Furthermore, austerity politics can be seen as important factor for both centralization of technological services within public sector organizations and increased outsourcing of developing new technological solutions.
	c) We can expect in such context that increased outsourcing of technological solutions and efficiency driven procurement practices weaken internal technological capacities.
	d) Many if not most public sector tasks are implemented in the context of complex legacy systems. As interoperability of data systems and platforms is a key issue of today's public sector technological change we expect to see more rapid technological change in case of simple as well as newly emerging services.
	e) Many new technological solutions have both internal (within public sector) and external impact; we can expect that latter is often not conceptualized or measured properly as auditing, measurement and fiscal procedures tend to focus on concrete organizations and activities.

Source: authors.

Methodology and Description of Cases

Our aim is to explain through an evolutionary framework how technology capacities evolve by comparing different public sector activities. We test this framework with nine case studies from Estonia: postal service, emergency medical service, public-transportation services, welfare services, social-insurance services, employment services, tax-collection service, internal-security services and e-residency. In order to provide exploratory insights, we selected cases with different characteristics. Thus, cases with different speeds of technological change in respective sectors, types of organizations in terms of their autonomy and feedback systems were selected in order to collect rich, bottom-up data. We expected to cover cases that represent different public sector tasks and contexts. Table 3 summaries the selection of cases.

Table 3: Overview of case studies

	Technological complexity of introduced solutions	**Organizational autonomy**	**Complexity of feedback system**	**Why interesting?**
Emergency medical service	Low	High	Moderate	NPM legacy present through contracting-out practices
Road and transport administration	Moderate	Moderate	Low	Divisional structure enables in-house comparisons
Tax and customs services	High	Moderate	Low	Classic example in technology and PA
Police	Moderate	Low	High	Epitomizes how organizational tasks have changed over time
Employment services	Moderate	Moderate	Moderate	Classic example, integration with other services (e.g. tax collection)
Welfare services	Low	Moderate	High	Strong "cost disease" effect
Postal service	High	High	Low	Fundamental change in tasks over the past decade (automatization)
Social insurance	Low	Moderate	Moderate	Fundamental welfare state function; scale economies possible
E-residency	High	Low	Low	Fully technology-enabled new public service; start-up government; public-service export

Source: authors.

The data was obtained from document analyses as well as 19 semi-structured interviews with representatives of the respective organizations (mostly heads of organizations, but in some cases heads of development or technology units; 14 interviews altogether), public organizations responsible for ICT infrastructure development in Estonia (4 altogether) and the organization responsible for auditing these developments.

In order to understand what kind of change in administrative capacity resulted from technological developments we first collected data on overall technological developments in all selected organizations and then, secondly, obtained more specific information on changes in internal administrative routines. For the latter we asked the interviewees about technology-driven changes in structure, division of tasks and management, developments towards real-time and automated service provision, integration of services (state-level infrastructure as well as inter-organizational collaboration), user-driven service design and also about in-house production vs externalization of technology development. We also asked the interviewees about the overall impact of technological change on organizational performance (productivity, change in core tasks, etc.).

In order to apply the conceptual framework for explaining and understanding change in technological capacities, we also obtained information on the feedback and selection environments. Namely, we asked the respondents about the sources of technological and related organizational change, the drivers and barriers of that change, the role of external stakeholders (from parent ministry to firms, policy networks and citizens), the feedback characteristics and the quality of inter-organizational interactions. A related aim was to understand what impacted the overall change of technological capacity in these organizations by taking into account both deterministic and structuralistic approaches.

The main co-evolutionary dynamics between technological change and administrative capacities in the studied cases are summarized in Table 4.

Table 4: The main dynamics between technological change and administrative capacities in the studied cases

	Main technology-enabled innovations	Change in technological capacity	Main feedback dynamics	Change in internal routines	Change in external routines
Emergency medical service	GPS assisted transportation planning	Static	Technology of secondary importance among powerful policy network stakeholders	No impact	No impact
Road and traffic administration	Automated traffic and road monitoring; do-it-yourself e-services	Static	Users' uptake as key selection mechanism; hierarchical feedback (productivity concerns)	Transition to e-services; task reallocation geographically leading to limited productivity increase	Change in service consumption causing radical productivity increase (time-savings)
Tax board	Automated services and data exchange; data analytics based services	Dynamic	Technology triggers positive feedback in all selection environments; internal and external productivity increase clearly evident	Data driven change in core tasks (e.g. shift towards risk-based evaluation methods) and reprioritization of tasks leading to radical productivity increase	Change in service consumption and increase in partners' technological skills
Police	GPS-assisted transportation planning; digitized back-office services and real-time information access (e-police)	Static	Technology does not trigger strong positive feedback loops in any selection environments	Digitalization of some existing routines; more centralized decision-making due to increased data collection capabilities	Very limited change in service consumption
Employment service	Digitized back-office services and real-time information access; technology-enabled do-it-yourself services	Static	Signals from hierarchical feedback mixed (high complexity leads to high coordination costs, while productivity concerns central)	Digitalization of some existing routines; more centralized decision-making due to increased data-collection capabilities	Very limited change in service consumption and technological skills of partners
Welfare services	Digitized back-office services and real-time information access	Static	Technology does not trigger strong positive feedback loops in any selection environments ("cost disease")	Strategic and back-office decision-making centralized due to increased data-collection capabilities; core service provision more de-centralized	No change
Postal service	From traditional postal services to semi-automated parcel services; do-it-yourself service provision	Dynamic	Strong market feedback	Technology induced radical change in business model; increase in productivity due to economies of scale; more flat organization	Limited change in service consumption
Social-insurance services	Digitized data exchange	Static	Hierarchical feedback gives mixed signals (public-sector complexity leads to high coordination costs, while productivity concerns central)	Digitalization of some existing routines; more centralized decision-making due to increased data-collection capabilities	Limited change
E-residency	Digital-ID-enabled access for foreign citizens to public- and private-sector services in Estonia	Dynamic	Strong market and policy network impact	Entirely new routines; economies of scale as key logic	Limited change

Discussion

As we can see from Table 4, our nine cases fall into two categories: 1) alpha organizations/services with strong and dynamically evolving technological capacities (3 cases); 2) beta organizations/services with low and static technological capacities (6 cases). In order to discuss the cases in detail, we follow the structure of our research questions and theoretical expectations, but in reverse order – this way we can explain why and how certain organizations become dynamic and others do not.

Why do some organization adopt or develop new technological solutions and others do not?

Following our framework we would expect that different feedback and selection mechanisms feed into the dynamic or static change in administrative capacities in the public sector. Table 5 pulls together our expectations and reflects the evolution of technological capacities in the Estonian public sector. As we will see, in all four selection and feedback mechanisms there is a marked difference between alpha and beta organizations; although some beta organizations have dynamic elements, the composition of these selection mechanisms seem to determine if new technological solutions are developed.

Table 5: Importance of feedback mechanisms

1. Citizens' feedback:	**a)** Diffusion of e-infrastructure makes citizens more open to new solutions.	Corroborated; the wide adoption of the id-card
	b) Privacy concerns among citizens function as a key selection mechanism: rapid technological change in public organizations where privacy concerns have little impact.	Privacy concerns in the case of Estonia have no effect
2. Market feedback:	**a)** External technological routines are key selection mechanisms of technological change in public organizations.	Corroborated
	b) Slow rate of technological change where market capabilities are fragmented.	Corroborated in the case of beta services
	c) Rapid rate of technological change where public procurement leads to the creation of new private niche markets or similar positive economic spillovers.	Not corroborated; only in limited cases (police and real time monitoring)
3. Network feedback:	**a)** Stakeholder-engagement practices have significant influence on technological change in the public sector.	Corroborated
	b) The degree of political power of stakeholders influences the evolution of technological capacities in the public sector depending on whether the dominant stakeholders possess dynamic or static technological routines.	Corroborated, but the effects vary between alpha and beta organizations
4. Hierarchical feedback	**a)** Austerity politics plays an important role in driving technological solutions.	Corroborated
	b) Austerity politics is an important factor for both centralization of technological services within public sector organizations and increased outsourcing of developing new technological solutions.	Corroborated in the case of beta services
	c) The increased outsourcing of technological solutions and efficiency-driven procurement practices weaken internal technological capacities.	Corroborated partly
	d) More rapid technological change in case of simple as well as newly emerging services.	Corroborated; in the case of alpha services, where new processes are created without strong hierarchical legacies, rapid change is easier
	e) External impact is often not conceptualized or measured properly, as auditing, measurement and fiscal procedures tend to focus on concrete organizations and activities.	Corroborated; areas where measurement is more simple, communication of results to other selection mechanisms – citizens, markets, networks – becomes easier

Source: authors.

On the whole, beta organizations that have experienced either slow change in their technological routines or have so far managed to experiment with a limited number of their services are constantly struggling to deliver minimum-level services in an equal manner to each and every citizen, making control, legitimacy and stability – hierarchical feedback – rather than technological change and potential economies of scale a key feedback source. **Citizens' feedback** has played a key role in some ser-

vices (tax, road, e-residency and postal services), while in other cases it has played either a moderate role (emergency medical services, social insurance, employment, police) or almost none at all (welfare services). While some beta services also have strong citizen-feedback systems (e.g. road services), the main difference between alpha and beta organizations/ service fields seems to be the link between technology and perceived value added for citizens. The easier it is to measure and thus communicate the performance of a public service, the quicker do the reactions from users feed back into the development of administrative capacities. This also means that productivity is key in communicating the need and impact of technology both within organization (from management to street-level bureaucrats) and outside organization (citizens, networks, market, public sector in general, esp. budgetary negotiations). The tax board is the clearest example here where this is relatively easy (the tax board plans to invest into a new IT platform worth two annual budgets), whereas in police this is more problematic as the causal link between technological capacity and organizational performance is more indirect ("how would you measure the cost of life?"). As an additional example, in case of welfare services for mentally disabled people there are many promising new technologies available for treatment and rehabilitation, yet hardly any interest or pressure exists from the relatives of the patients to develop these services. It is still the human component in their core tasks that matters most.

For beta organizations efficiency in the form of time-saving can be an important factor for technological developments. For example, the Road Authority managed to cut the issuing of driving licenses from two weeks to two days without any need to visit the office physically. At the same time, for the Emergency Call Center the next ambition is to cut some seconds in responding to calls, and for Rescue Board some minutes to react to incoming calls (altogether 1.5 million emergency calls a year). However, for emergency medical service, police, rescue and other internal security and health-care providers the added value comes mostly if technology enables real-time monitoring and decision-making in order to save lives. Whereas in the case of driving licenses it is a question of time-saving for the sake of more comfortable services.

We also detect explicit attempts to change the feedback environment through public campaigns, marketing and nudging (e.g. road authority, tax board, e-residency) to generate more technology-friendly feedback. However, as indicated above, apart from some notable exceptions (postal services, e-residency) the almost non-existing real-time user feedback has to be considered here as the key reason for the limited impact of technology on administrative capacities. Again, alpha organizations tend to clearly differ from beta organizations.

When it comes to **market feedback** the change is surprisingly limited in both alpha and beta organizations. In specific cases – e.g. police and the search for real-time data analytics – organizations may have created positive spill-overs, however, at the moment it is rather meagre. Technology outsourcing has only seldom led to positive market spillovers in terms of new niche-market creation or the development of new market capabilities (see on Estonia in general in Lember and Kalvet 2014). The market is still very fragmented when it comes to providing new technologies for the public sector. Public sector products are mostly available in areas of back-office and support services, providing a more dynamic environment for change. When it comes to core tasks, the public sector mostly utilizes private sector tailor-made solutions to problems that the public sector itself identifies. As tailor-made solutions are predominantly outsourced, come with considerable costs and are difficult to implement on-time, market signals alone are often too weak to enforce positive feedback loops.

In terms of **network feedback** we can detect some evidence that alpha organizations have stronger network feedback linkages than beta organizations. For example, in the case of the tax board there is a constant pressure from private-sector interest groups to hold the board accountable, meaning that the tax board has to be able to communicate clearly the benefits from any changes in tax collection. And the technological capacities are key in making this possible (e.g. the 1000K bills case). At the same time the policy network has been the primary reason why the evolution of technological capacities has been slow in the field of emergency medical service. There are strong policy stakeholders in this field (physicians, autonomous service providers, local governments) whose technology capabilities as well as interests diverge from the government but had a considerable power over the policy process. This case also demonstrates how authority issues tend to prevail if conflicts emerge with other selection criteria (e.g. potential technology-enabled productivity increase).

In terms of **hierarchical feedback**, cost-cutting, performance improvement and productivity increase are the main (at least rhetorical) triggering and legitimizing arguments used in the public sector. Many interviewees admitted that austerity policies have brought technology to the fore as a potential solution to increase organizational productivity, yet this is in most cases not measured directly. The cases of alpha organizations – tax collection (change is easily measurable), postal service (their bottom line determines their survival in the market context) and e-residency (the real-time performance metrics is inherent to the service) – are the exceptions here. Time saved for citizens is often the main productivity indicator (i.e.

external effects), but especially for beta organizations this often comes with increasing costs for public organization (investments and maintenance of ICT systems being costly).

The positive feedback loop is more likely to emerge in case of simple and newer rather than old legacy systems. For example, one can argue that the rapid technological change in the tax board has taken place because of the relatively simple tax system in Estonia and the small size of the country (only 20 MEUR investments into ICT systems over the past two decades was needed). Similarly, the postal service switched to an entirely new and emerging service area, effectively avoiding the traps of the old postal system. E-residency as a service platform was developed from scratch. In other areas, the services are tightly integrated with other service areas and the centralized data exchange infrastructure, limiting the autonomy to make radical changes and rising coordination costs associated with new developments.

Interestingly, most of the interviewees admitted that public procurement regulation is not a significant barrier to technological change. This is surprising and contrary to what we expected. However, this should be understood as relative to other often-mentioned barriers, such as lack of technology-embracing leaders, constantly changing legal norms, sticky legal dogmas or inter-organizational complexity. As one interviewee put it: "I clearly see that the public sector is far away from the technological frontier, and I cannot explain why. And although public procurement as such has not held us back, I do see the need to develop more in-house technical skills for us to be able to move faster". Also, we did not see any examples of risky procurement projects undertaken that would have enforced radically new technological capacities, implying indirectly that experiences with the public procurement process still feeds back strongly to the evolution of internal technological routines.

Another surprising finding was that no public sector organizations admitted that there was a pressure for technological change from parent ministries. This implies that in spite of the political rhetoric related to austerity or gaining global technological leadership, policy thinking on the ministerial level is almost completely technology-free in Estonia. And whereas some organizations see the centralized ICT competence centers as problematic, it is often the centralized IT agencies that initiate technological change in the public sector rather than the actual units responsible for service policy or provision, linking the evolution of technological capacities closely to how the centralized units interact with the actual public-service providers and implement technology projects. Many respondents claimed that there is a generic lack of technological cham-

pions both in policy-making and service-provision organizations. This means that the technological change depends not necessarily on the logic of the public service, but on the external capacities of specialized public IT agencies. As one respondent from a dedicated IT agency put it, "As of today we initiate most of the technological projects, and the main driver for us is to save time for our organization, so that we would eventually have more time for substantial developments and innovation."

And when it comes to evaluation practices, ICT-based solutions (a better overview of the state of affairs through data analytics and monitoring) have enabled many organizations to increase their capabilities to articulate their problems in front of the public sector stakeholders. As a result, increased data capacity can feed back to further technological developments as changes in policies are easier to achieve.

How does technological change influence administrative capacity in public organizations?

Estonia has an international image of being one of the front-runners in using modern technology in providing public services. Yet the empirical evidence gathered in this study demonstrates that beyond introducing a well-functioning basic data-exchange infrastructure the technological change has only modestly affected the evolution of the administrative capacities of public organizations.

In alpha organizations/services – providing tax, postal and e-residency services – administrative capacities have rapidly increased because of technological change. All three of these organizations are distinctively different in how they organize their core tasks today, compared to only five or ten years ago. We can argue that these organizations have developed strong technological capacities. These organizations are also ambidextrous: they manage to introduce new radical technological solutions and keep providing services required by laws and regulations and often improve service provision.

Correspondingly, it can be seen that the introduction of new technologies cumulatively leads to both changes in work tasks and what skills the staff is expected to possess. For example, in the tax board the increasing data-analytical capacities have changed how certain tasks are carried out (e.g. controlling used to be mostly about interacting with specific firms or individuals by demanding and collecting information, whereas now the data is readily available and the main task is to analyze the existing data) and what skills are needed to carry out those tasks (the emphasis changed from communication and information collection to data-analytical skills). We did not see this to be the case in beta organizations.

When it comes to external routines, we can see that in all three alpha cases the rapid change in internal technological routines has taken place hand in hand with rapidly increasing external technological routines. In all three cases the main external partners act in contexts where rapidly increasing technological capacities are the norm. Austerity-driven political context has significantly empowered the tax board and it is in a position where it can dictate to citizens, but especially private firms, to upgrade their technological skills and adjust their technological processes, even if they are reluctant to do so due to associated costs.[7] In case of postal services the supply of high-tech parcel equipment and software solutions by the market is rapidly increasing, making it possible for the state-owned enterprise to forge ahead with internal technological capacities. And as parcel services do not need to be supplied universally, it means that the state-owned firm can concentrate on more technology-prone users and partners. In the case of e-residency, the main Estonian e-service users are highly educated and ICT-able foreign individuals and companies, making this service highly particularistic and exclusive by design.

All other cases (beta organizations/services) represent more typical public services, and here we see a much slower change in technological capacities. These are organizations characterized by slow rather than rapid change in technological routines, and they have mostly started to digitize their support and back-office functions and have occasionally experimented with new technological solutions in carrying out their core tasks. However, overall, technology has had a limited impact on how their administrative capacities have changed. And thus, we can argue that their technological capacities are low and static in nature. The interviewees acknowledged that in general there is either not much technological "innovation" happening or many more innovations could happen compared to today's situation. For these organizations, outsourcing and procurement of technological solutions and, in some cases (emergency medical service, police, social insurance), centralizations of the core public-sector capabilities on a ministerial level or in a dedicated centralized agency have led to rather limited in-house technology skills (1-2 people in most cases). Relatedly, as in-house capabilities are limited also the relational capacity to search, understand and exploit new

7 For example, in 2014 it became compulsory for companies to declare bills over 1000 EUR. While there were claims of increased administrative burden to companies, the tax board provided a machine-to-machine solution to firms to declare the bills straight from their accounting software. It took only a month to understand from increased VAT revenues that the technology investments paid off. The same happened with another reform: the electronic employment register caused the black market in construction to go down from 27% to 7% in less than a year.

technologies is limited. This situation is further complicated by low IT skills among service provision staff in many sectors. For example, nurses in general lack technological skills, making it difficult to engage them in the service-innovation journey in welfare and emergency medical service. Similarly, the road authority saw a strong opposition from road engineers when attempting to digitize road monitoring and maintenance services.

Tailor-made IT systems and related service-provision systems that are unique to a single organization are the norm in Estonia. Even if some organizations already possess certain technological capacities that other organizations need, there is almost no inter-organizational collaboration or service integration in terms of shared service-provision platforms. The same is true for open-data use – there is very little use of open data. This seems to have a strong impact on beta organizations. Here, however, Estonia is crucially different from other countries, as the X-road system is considered an effective generic data-exchange platform.

Most crucially, in beta organizations user feedback is only sporadically integrated into service-delivery systems, where trust surveys, recommendation indices and similar tools are used to catch anomalies rather than to automatically feed information back to every-day service re-design and delivery.

Conclusions

One of the most striking paradoxes that emerged from the Estonian case study is related to the slow rate of change in technological capacities in a seemingly technology-friendly wider context. On the one hand, there is a strong austerity-driven push for budget cutbacks and productivity increase, and most of the interviewed public-sector leaders were very knowledgeable about the potential of technology in their fields, and no interviewee identified any privacy-related issues that would act as a major hindrance to technological developments. And yet, on the other hand, almost all interviewed civil servants acknowledged that their organizations are either very or relatively far from the technological frontier (in the sense of both creating new and adapting existing technological solutions). We use our framework of selection mechanisms to explain this puzzle and highlight why two diverging groups of organizations emerge: first the group of (alpha) organizations that show radical change in administrative capacity and become ambidextrous and second those (beta organizations) that do not.

First and foremost, many of the technology-driven organizational changes assume that all relevant public sector partners within a specific organizational field were willing to simultaneously adapt their technological routines. This is difficult where **hierarchical** legacies and feedback mechanisms prevail. Following Teece (2009) this often leads the existing administrative routines to prevail over existing or emerging technological capacities. Thus, it is predominantly the complexity of inter-organizational dependency and relationships as a selection environment within the public sector that influences why certain public organizations are able or unable to develop technological capacities. Importantly, coordination capacities can be seen here as a key function of dynamic technological capacities.

Therefore, autonomy from other public and private sector organizations, i.e. the ability to challenge the existing institutional context and deviate from the existing norms, is key. This is not related only to leaders willing to take risks (although this is relevant), but also to the extent to which an organization can change its internal and external technological routines without needing to coordinate and push other public organizations to do the same. The respective organizations in cases of e-residency, tax authority and postal services possessed a relatively high level of autonomy in their strategic and operational choices, whereas, for example, social insurance and employment authorities do not.

Second, the **market** feedback and selection environments are more fragmented, and the feedback to develop radically different technological routines can be considered weak. This goes against popular beliefs that governments are either driven to emulate 'start-up culture' or are toys for big technology companies.

Third, technology is not central to how **policy networks** operate and allocate power. However, depending on the policy context networks have an influence on the rate of the adoption of technological solutions.

Fourth, **citizen feedback**, in spite of rapid change in ICT solutions, is still not intrinsic in service delivery. Only in cases where effects are easily measured do positive feedback cycles to technological development in the public sector exist. Thus, the nature of the specific service – from postal to welfare, from simple to legacy services – is still an important determinant in the evolution of technological capacity. Therefore, as we also saw from a case study in the city of Tallinn (Lember et al., 2016), the use of technology leads to parallel temporalities in the public sector: quick developments in easy-to-measure services (both within and through the public sector) and where user skills match new technological solu-

tions, and slow change where feedback mechanisms are blurry (trust and legitimacy issues are more important than technological advances). And the human component is still central to many public services, ultimately determining to what extent automatization is desirable and feasible.

By these findings we aimed to demonstrate empirically that technology is in a co-evolutionary relationship with both organizational resources and authority and that this co-evolutionary relationship is influenced by four different feedback and selection environments. The Estonian cases show how technological advances (ease of use of new tech solutions, cheapness, layering of options) make both frameworks of administrative capacity (resources and authority) open-ended for internal (new division of tasks or even new prioritization of tasks) and external (new coordination pathways) changes of administrative capacity. Thus, alongside other contextual and internal factors that we know more about already, technology becomes an intrinsic factor in how administrative capacity evolves. Although these are preliminary findings, the paper's main point is that technology should be seen as a key factor of public-sector change, and its role should be analyzed following evolutionary analytical frameworks. Future research should especially look at how exactly dynamic capacities in the public sector are structured and constructed within organizations. This is especially relevant in the wake of new technological opportunities, such as fully digitized on-demand service provision or emerging machine-to-machine coordination in the public sector that not only assumes and possibly brings along radical change in public-sector organizations, but that also makes one re-think accountability, equal treatment, privacy and other fundamental building blocks of the public sector.

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