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TECHNICAL DEBT IN THE MUNICIPALITY SECTOR - THE MISSING LINK WITH CITIZENS AND SILOFICATION

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Research paper

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Abstract

Public sector organizations suffer from high levels of technical debt (TD). TD leaves digital infrastructures in a derelict state, making digital transformations costly and risky. Though there is growing research about TD, most studies focus on private businesses. In this study, we conduct a case study examining the TD in a Swedish municipality, analyzing archival data such as project reports, municipality blog posts on digital transformation, and goals to improve citizen experience. We focus on four information systems that support permit application processes. Analysis results reveal the common TD types, consequences, and possible causes. Departments work in silos, case managers' perspective is prevalent in requirements, while citizens only have a passive role as system users. These lead to various types of TD and high costs when integrating legacy systems into a coherent IT architecture. By diving deep into the data from a digitalization forerunner municipality, we identify TD in the municipality sector and increase understanding of how TD influences digital transformation. Results give a stable ground for further research and practice on mitigating the debt.

Keywords: Technical debt, public sector, municipality, citizens, silofication

1 Introduction

It is increasingly urgent to address out-of-hand technical debt (TD) in the public sector, as it has become a severe barrier to digital government and hinders service efficiency (UK government, 2020; Wilson & Mergel, 2022). Most of the $100 billion spent by the government on technology in the US in 2021 was allocated to the operation and maintenance of legacy technology (Kunert, 2022; US Government Accountability Office, 2022). The Swedish National Audit Office review report (2019:28) shows that among the 63 people from different authorities that responded to their questions, 45 indicated that there are outdated IT systems in their authorities (Swedish National Audit Office, 2019). UK government's report reveals that, according to Government Security's analysis, nearly 50% of the current IT expenditure by the Government, £2.3BN out of a total central Government spend of £4.7BN in 2019, is spent on maintaining outdated legacy systems, commonly referred to as "keeping the lights on" activity (or KTLO). Moreover, the report estimates a potential risk of £13-22BN over the next five years directly related to this issue (UK Government, 2020). Legacy IT systems gradually accumulate TD increasing maintenance costs over time and thus making any future infrastructure changes risky and expensive (Rolland et al., 2018; Rolland and Lyytinen, 2021). Shortcomings in IT competence within the public sector can result in a failure to recognize TD, which, in turn, can lead to significant underinvestment in modernizing the digital infrastructure.

There are growing numbers of studies about TD, and most of the studies are about TD in the private sector (Nielsen, 2020). The public sector differs from the private sector on several aspects. The private sector is primarily driven by profit motives, which compels companies to prioritize efficiency, to stay ahead of their competitors and remain relevant in their respective markets. In the public sector, the authorities have their specific missions, and in most cases, they do not compete with other authorities or with private sector actors. Citizens must adapt to the tools provided by the public sector authorities in order to use the services - there are no alternative solutions to choose from. The different external environment and organizational logic may influence the characteristics of TD in the public sector. In this study, we aim to address the following research questions: *What is TD in the public sector, especially the municipality sector? What are the causes of the various types of TD in the public sector?*

We conducted a case study in a Swedish municipality to address the research questions. We examined four different IT systems: Building Permits Application System (ByggR), Environmental Permits Application System (Ecos2), Serving Permit System (Alk T), and Parking Permit System (Procapita) from four departments. These systems are not isolated objects. Rather than examining these systems in isolation, our analysis focuses on their role within the work processes they are designed to support or are integrated into. Through the analysis, we identify different types of TD, following and extending the classification of TD in Rios et al. (2018). We describe the characteristics of the debt, what consequences the debt leads to, and discuss the causes of the debt. Our findings open avenues for future research in public sector settings and are also relevant for practitioners trying to understand and mitigate TD.

2 Technical Debt

TD describes an accumulation of software maintenance obligations that need to be repaid in the future (Ramasubbu and Kemerer, 2016). Cunningham (1992) first introduced the concept of TD to describe coding practice where developers employ quick-and-dirty solutions to address pressing problems. Left unattended, these solutions would cause problems in the future. He leveraged the metaphor of financial debt to help financial sector managers understand the consequences of certain software development practices: "*Shipping first-time code is like going into debt. A little debt speeds development so long as it is paid back promptly with a rewrite… The danger occurs when the debt is not repaid. Every minute spent on not-quite-right code counts as interest on that debt.*" (Cunningham, 1992).

The research on TD has gradually evolved to encompass aspects of software design and development beyond coding (Li et al., 2015; Rios et al., 2018). Rolland et al. (2018) discussed the notion of digital debt, including technical and social aspects. Social aspects of debt cover failures in communication, management, and governance. Avgeriou et al. (2015) considered TD "*a collection of design or implementation constructs that are expedient in the short term, but set up a technical context that can make future changes more costly or impossible.*" The authors also noted that TD has far-reaching consequences, including negative impacts on system quality, value, and costs of future changes. Accumulated TD can also contribute to the creation of technological *inertia,* where the IT decisions are heavily influenced by existing legacy systems, making certain options for future action unavailable (Rinta-Kahila et al., 2023). Mäki et al. (2023) states that TD comes in various types, depending on where in the IT system the debt accumulates and at the levels of software code, design, testing, requirements specification, IT infrastructure, IT architecture, data, documentation, and people. By now, TD spans from a traditional engineering point of view to a socio-technical point of view, and it's the latter that we focus on in this article.

TD can appear because of the technical redesign, change of architecture, workarounds, and shortcuts in the development process, or evolution of desired functionality of the system (Woodard et al., 2013; Ernst et al., 2021). While some TD is avoidable, it is simultaneously a natural by-product of the design process (Sullivan et al., 2001). TD could be reckless and inadvertent, resulting in minimal gain, or deliberate and prudent, where debt is generated to achieve specific objectives, and where the plan to repay the debt exists (Woodard et al., 2013). A well-planned TD can even generate digital options, affording the organization speed, flexibility, and scalability of operations (Rolland et al., 2018). On the other hand, inadvertent TD may go unnoticed due to its perceived insignificance or failures in communication and documentation (Tom et al., 2013). In such cases, the TD may only be recognized when it poses significant issues, such as preventing the development and deployment of new features (Tom et al., 2013; Ernst et al., 2021).

As Nielsen and Madsen pointed out, TD is a relevant research topic for digital government research in the public sector. Public sector needs to innovate and deliver better services to citizens and businesses using emergent technologies (Lindgren et al., 2019). It is important to investigate TD in the public sector because TD can hinder the public sector from realizing the benefits of digitalization. However, currently there is a lack of research on TD in the public sector - most of the studies about TD are in the private sector, and in a systematic literature review conducted by Nielsen et al. (2020), among the 49 papers reviewed, only one study is in the context of the public sector. To the best of our knowledge, few studies discuss TD in the public sector in the context of a change in the external environment and digital transformation (e.g., Nielsen and Madsen, 2022). As noted in the introduction, the external environment and organizational logic vary between the public and private sectors. Thus, examining the characteristics and causes of public sector TD is of interest.

3 Methodology

We conducted an explorative case study at Sundsvall municipality, Sweden. The case study approach suits the purpose as this is a contemporary phenomenon within its real-life context, and the boundaries between phenomenon and context are unclear (Yin, 1994). Specifically, we examined four information systems used to process various permit applications: Building Permits Application System (ByggR), Environmental Permits Application System (Ecos2), Serving Permit System (Alk T), and Parking Permit System (Procapita). In the analysis, instead of viewing the systems as isolated software objects, we examined them in the context of the work processes that they are supposed to support (or part of). As prior research noted, examining TD in actual cases allows researchers to gain an in-depth understanding of the relationship between TD and the context (Dong et al., 2019).

We had extensive access to archival documents, reports, pre-studies, and public communication related to the municipality's information systems and digitalization strategy, all of which is available under regulations of the Swedish principle of public access to official records. The first author, who works at the case organization in a managerial role, had direct access to this data. He has also extensive expert

knowledge of the domain and has been working with all four projects investigated in this study. Table 1 describes some of the data used in this study. We applied thematic analysis to our data to identify key themes related to TD in each of the four information sources. We used core concepts from TD literature (e.g., Rolland et al., 2018; Ernst et al., 2021; Nielsen and Madsen, 2022, Mäki et al., 2023) to identify the themes.

Source Material	Description
Municipality of Sundsvall digitalization strategy 2019-2022	The digitalization strategy in the municipality of Sundsvall 2019-2022 (decided in February 2019). The digitalization strategy was produced on behalf of the CIO/CDO in the municipality and decided upon by the municipal council.
Strategy for sustainable digital development to 2030	The digitalization strategy in the municipality of Sundsvall 2023-2030 (decided in December 2022). As for the prior one, this digitalization strategy was also produced on behalf of the CIO/CDO in the municipality and decided upon by the municipal council.
Pre-study report: Digitization of the building permit process	The pre-study report, including estimated increased customer value and decreased administration efforts for managing the building permit process, and citizens' perspectives of the building permit application experience. Part of the report is based on an analysis of 23 interviews, 14 were citizens, 7 were business owners, 1 represented a sports association, and 1 represented a housing cooperative. The pre-study was ordered by the building permit department and written together with the digitalization unit.
Blog posts on utveckling.sundsvall.se	The Posts that relate to the TD in the municipality sector from Sundsvall municipality's website about their digitalization journey

Table 1: A summary of selected archival and document data

4 Research Context

We examined in detail the information systems in the municipality of Sundsvall (in Sweden). The municipality of Sundsvall has about 100,000 residents and is a relatively big municipality, given that the median size municipality in Sweden has about 20,000 residents. With around 8,000 employees, the municipality organization is the largest employer in the area, and its primary objective is to provide services and welfare to meet the needs of residents.

The municipality of Sundsvall is an interesting case for analysis as it is well-known for its digitalization effort nationally: it is recognized as one of the Swedish forerunners in digitalization in the municipality sector of Sweden and was chosen as the digital municipality of the year in 2022. The digitalization journey so far has given a lot of insights about the challenges the TD generates, which motivates Sundsvall further to develop in this area.

The case organization is traditionally organized in committees, administrative units, and municipalities-owned companies, guided by political steering. However, each part of the organization has autonomy in solving their respective assignments, including what IT solutions to use to support their work.

4.1 Case context: Swedish municipalities

There are significant differences between municipalities and other public sector authorities, and the municipality sector in Sweden has a broad range of responsibilities. By law, municipalities are the local authority in several areas - areas where the municipality exercises authority in a high number of

processes with low case volumes. Municipalities operate in the following (functional) areas: social care (elderly and disabled care including individual and family care), pre-, primary, and secondary school as well as municipal adult education, planning and construction issues (building permits and more), environmental and health protection, cleaning and waste management, water and sewer, rescue services, crisis preparedness, and civil defense, library operations, and residences. The municipalities also have a range of voluntary assignments, which are not directly required by law, including leisure and culture, energy, employment, trade, and industry development (Sveriges kommuner och regioner, n.d.).

Municipality sector tasks are in stark contrast to national public sector actors with more focused assignments and high transaction volumes. In Sweden, there are approximately 340 authorities (Regeringskansliet, 2023) that assist the government in implementing specific tasks, for example, the tax agency (Skatteverket), the employment agency (Arbetsförmedlingen), the migration agency (Migrationsverket) and the pensions agency (Pensionsmyndigheten).

"[..] As there are not several major authorities with exactly the same needs, there is no supplier market with standard systems and instead, the authorities develop their own solutions. [..] There are 290 municipalities, all with basically the same mission. Where each administration and company have a special area in which they have assignments, you can say that a municipality consists of about 20 different authorities under the umbrella of one organization." Translated from Swedish, blog-post, Jari Koponen, Sundsvall Municipality (2020)

This wide range of services offered by the municipality leads to unique challenges that are not typically encountered in the public sector.

4.2 Case organization: digital transformation to improve service quality and citizen experience

Since 2018, the case organization has been implementing a comprehensive digitalization program, driven by the organizational unit Digital Transformation. This initiative is being carried out in parallel with all the administrative units, municipality-owned companies, and IT operations.

"In the municipality of Sundsvall, we use the possibilities of digitization to improve the quality and increase security in the municipal service. By making municipal operations more efficient, we free up time and resources to strengthen democracy, and increase the participation and independence of Sundsvall's residents." Translated from Swedish, A strategy for sustainable digital development, Sundsvall Municipality (2022).

Specifically, in the digitization program, the municipality emphasized improving citizens' experiences in interacting with the municipality. The program aims to improve the accessibility and efficiency of the municipality's services.

"We must increase the proportion of digital interactions with the municipality, where the meeting is experienced as simple, effective, and value-creating for the target group. By handling the majority of matters to and from the municipality digitally, resources can be allocated over time to meetings where human interaction creates great value. An increased digital self-service that is perceived as simple and value-creating also creates positive effects among the target group, who receive faster and simpler service." Translated from Swedish, A strategy for sustainable digital development, Sundsvall Municipality (2022).

To achieve these goals, the *municipality* needs to integrate various systems from different departments and subunits into a cohesive ecosystem of digital solutions. However, the digital transformation is challenging: the legacy information systems in each department are isolated and integrating them into an overall IT architecture is challenging.

4.3 Example: digitalization of permit service flow

Today, with the municipality's siloed ways of working, citizens and business owners need to apply for their permits at each respective department. The way of submitting applications varies from department to department, some departments have built e-services to facilitate digital registration, and other departments only collect applications through physical mail. For example, for a future restaurant owner, this leads to a complex and scattered application process where up to thirteen different permits need to be applied for in five departments and with no available support to keep it all together (illustrated in Figure 1).

To provide citizens and business owners with a comprehensive experience across different permit applications, it is essential to provide citizens and business owners with a portal that integrates a wide range of services, allowing them to initiate applications and inquiries, track their applications' statuses, and to access data regarding their applications.

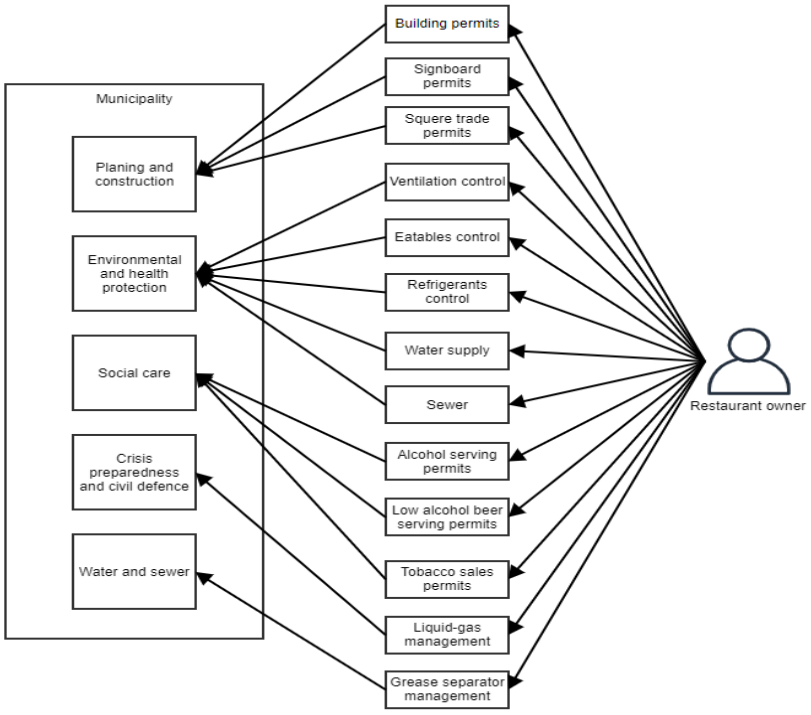

Figure 1. A restaurant owner needs to apply for thirteen different permits from five departments. The figure is adapted from a figure in Final Report (Explorer Mode) Project Business Centre.

Improving processes and user experience of citizens and business owners will naturally lead to streamlining of the case managers' processes, which will result in reduced administrative workload in the municipal organization.

"I claim; if instead of focusing on the life cycle of administration-specific civil service cases, we put our energy into solving the needs of our stakeholders (the citizen, the entrepreneur, the employee, etc.), as efficiently as possible with as high a degree of automation as possible, then we can deliver a better service at the same time as we streamline our administration and handling by 50-80% (depending on the type of case)!" Translated from Swedish, blog-post: Per Persson, Sundsvall Municipality (2021).

5 Analysis and Findings

In this section, we first analyze the four different permit application systems and identify the TD of each system, mainly elaborating on the analysis of the ByggR and Alk T systems, as in terms of the TD they embed, the Ecos2 system is very similar to ByggR, and the Procapita system very similar to

Alk T system. We then discuss TD from the municipality level, from citizens' perspective, and identify possible causes of TD.

5.1 Analysis of the Building Permits Application System (ByggR)

The building permits management system was introduced in 2010 in the Building Permit Department (Bygglovsavdelningen), which is a part of the City Planning Office (Stadsbyggnadskontoret) as a replacement of the previous system, which was provided by the same vendor. The replacement took place as the previous system had reached the end of life. The same vendor has been providing systems for building permit management (ByggR and its predecessors) for around twenty years.

Through the provided WebService-interface, it is possible to extract a subset of the data. This interface, available for an additional cost, allows access to part of the system's data, though not all. The WebService-interface lacks thorough documentation, and the supplier does not have a proper lifecycle-management process. Consequently, when the supplier upgrades the system and changes the interface of the WebService, compatibility with existing integrations is broken, creating problems for the integrating parties.

Analysis of the system also reveals that the system is designed solely from the perspective of a permit case manager. Citizens and business owners only have limited opportunity to digitally interact with the information systems at any stage of the permit application process. In other words, citizens and business owners are not considered users of building permit application systems. They can only submit certain types of applications through the system, cannot track the status for all case types through the system, and the system lacks functionality of digitally notifying applicants about the application results for all case types by the system. As a result of the case manager-centered design (the lack of focus on the applicant's user experience), about 40% of all applications need additional information from the applicant to be completed and processed.

Table 2 summarizes the debt identified in the building permit application system. We mainly adopt the TD types identified in Rios et al. (2018), and extend certain aspects of TD, such as requirements debt. Rios et al. (2018) described requirements debt as "Refers to trade-offs made concerning what requirements the development team needs to implement or how to implement them. In other words, it refers to the distance between the optimal requirements specification and the actual system implementation." In our research, we found that problems in the system do not arise solely from a mismatch between optimal requirements and system implementation. Rather, the issues stem from incomplete identification of initial user requirements. In other words, the system's requirements are incomplete. For example, certain user groups are left out of the requirements-gathering process.

We also observed there is significant TD about data-related issues. Data debt is explicitly discussed in our analysis. We define data debt as data-related challenges, such as difficulty in extracting data and data ownership issues. For example, the organization does not own the data generated from its business processes when it would like to use business intelligence systems to analyze the data. The municipality must purchase a supplier consultant's service to retrieve a certain portion of the data generated through the organization's processes. This series of events happened in our case organization; they had to pay the system supplier to get data. We also analyzed the Environmental Permits application system (Ecos2), and the problems are similar.

5.2 Analysis of the Serving Permit System (Alk T)

When businesses want to sell alcohol, they need to apply for a serving permit (alcohol license). The business owner needs to print out and fill in the proper form on paper or register its case in an e-service and submit it by post or digital to the unit for serving permit under the Individual and the Labour Market department (Individ och Arbetsmarknadsavdelningen) which manages about 100 cases per year. A case manager will go through the application and input the data from the sent-in paper, or a printed pdf fetched from the e-service to the serving permit system. The serving permit system (Alk T) has been in place at the municipality since 2003 and is used for this specific purpose. If a business is reported for violating the regulations, for example, by selling alcohol to people under the age of 18, such a report will be received by the Individual and the Labor Market department and entered into the

serving permit system. The system will not automatically notify the relevant parties, such as the business, or other relevant parties. The staff at the Individual and the Labor Market department must notify the business or other departments through email or phone or other channels. Some data is also not present in digital form at all and maintained on paper. For example, the ID that is the master ID for each registered business is not in the system but maintained on paper. We also analyzed the parking permit system (Procapita), and the TD identified is similar to that of the serving permit system. Table 2 below summarizes the investigated TD of Bygg R and Alk T.

TD Type	Definition	Description and Consequences of TD	
		ByggR	Alk T
Architecture debt	"Refers to the problems encountered in product architecture, which can affect architectural requirements. Usually, architectural debt could be the result of sub-optimal upfront solutions, or solutions that become sub-optimal as technologies and patterns become superseded, compromising some internal quality aspects, such as maintainability." (Rios et al., 2018). For example, the architecture has little integration capability, and is designed mainly as a standalone system.	The system is not properly integrated into the existing IT landscape. Integration is complicated and costly, and only part of the system can be integrated.	The system cannot be integrated into the existing IT landscape. Required reports to other public authorities are handled completely manually. All cases need to be manually registered in a formal application record as well (all cases are registered twice) since this system lacks the application record status in the municipality.
Requirement debt	Incomplete identification of requirements. For example, certain user groups are left out when identifying requirements, or integration-related requirements are missing. We extend the definition of technical debt by Rios et al. (2018). "Refers to tradeoffs made with respect to what requirements the development team needs to implement or how to implement them. In other words, it refers to the distance between the optimal requirements specification and the actual system implementation" (Rios et al., 2018).	Requirements are based on a case manager's perspective, not from the citizen's perspective, which makes it impossible to allow citizens to interact with the system fully. Furthermore, supporting citizens' interaction with the municipality over several subunits is impossible. Lack of integration in related requirements leads to challenges in integrating the system with other systems.	Requirements are based on a case manager's perspective, not from the business owner's perspective, which makes it impossible to allow business owners to interact with the system. Furthermore, it is impossible to support business owners' interactions with the municipality that span several subunits, similar to that of the building permit system (ByggR) case.

	It can also arise if some needs are not fully addressed during the system's life cycle, and not only when the system is initially built. (Kruchten et al., 2012).		
Test debt	Issues found in testing activities can lead to costs in the future and refers to "issues found in testing activities that can affect the quality of those activities" (Rios et al., 2018). We also investigated the dimension of testability - if test-environments and test-processes were in place.	There is no testing process, nor proper test phase in place, which leads to the integration not properly regression-tested when the system is upgraded. The regress test assures that the newly integrated component works as expected, the other components also work as expected and are not influenced by the change. Sometimes these integrations break after a system upgrade, which then requires unnecessary incident management.	The system lacks testing environments. Tests cannot be performed before the release of new upgrades.
Infrastructure debt	"Refers to infrastructure issues that, if present in the software organization, can delay or hinder some development activities" (Rios et al., 2018) - issues that leave information systems falling short of modern standards and requirements. Lack of continuous integration between old and new production systems could fall under this category (Li et al., 2015).	Even though both ByggR and Alk T may have been appropriate for the departments when they were first purchased, today, these systems seem outdated. The failure to keep up with technological advancements, adapt to new standards, and adjust to the demand for more efficient case management processes and increased digital support from citizens and business owners have rendered the systems obsolete.	
Documentation debt	"Refers to the problems found in software project documentation. - Missing documentation - Inadequate documentation - Outdated documentation - Incomplete documentation" (Rios et al., 2018).	Several parts of the system lack proper documentation. For example, the system's WebService interface description is both inadequate and incomplete, giving a high risk that an implemented integration do not work properly.	The system completely lacks documentation.
Process debt	"Refers to inefficient processes, e.g., what the process was designed to handle may be no longer	The system is designed to reflect what data a case manager needs to collect and manage during an application	The system is designed to reflect how the case manager manually manages the case, similar

	appropriate." (Rios et al., 2018).	process, but the actual process is not defined. In other words, the system is not designed to optimize the work process but to replicate the information model that existed in manual case management. The system does not prompt the case manager. Instead, the case manager decides the next step in the work process. As a result, it is impossible to automate the case management process in the current system and risks the legal security of the application process.	to the building permit system (ByggR) case.
Data debt	Data related challenges, such as data that is incorrectly formatted, inaccurate, redundant, absent altogether and very hard or impossible to access. In some cases there are data ownership issues as well - there are cases where the municipality, based on the vendor contract, does not own its own data. Employee workarounds to bad data may increase complexity, thereby impairing the whole information system's maintainability (Foidl et al., 2019).	Through WebService Interface, part of the data can be accessed. Accessing all the data in the systems without consultant help from the vendors is impossible.	Data can only be displayed in the system's user interface. There is no API or other tools to get the data in a ready-to-use format for other systems. To get the data in ready-to-use format, vendor consultants' services are needed.

Table 2. Summary of the TD in ByggR and Alk T

5.3 Analysis at the municipality level

Our analysis of the building permit case system (ByggR), the environment permit system (Ecos2), the serving permit system (Alk T), and the parking permit system (Procapita) shows that the systems primarily focus on local tasks and are designed to support the manual work process. Figure 2 illustrates the siloed case management work practice and siloed systems in the context of permit applications.

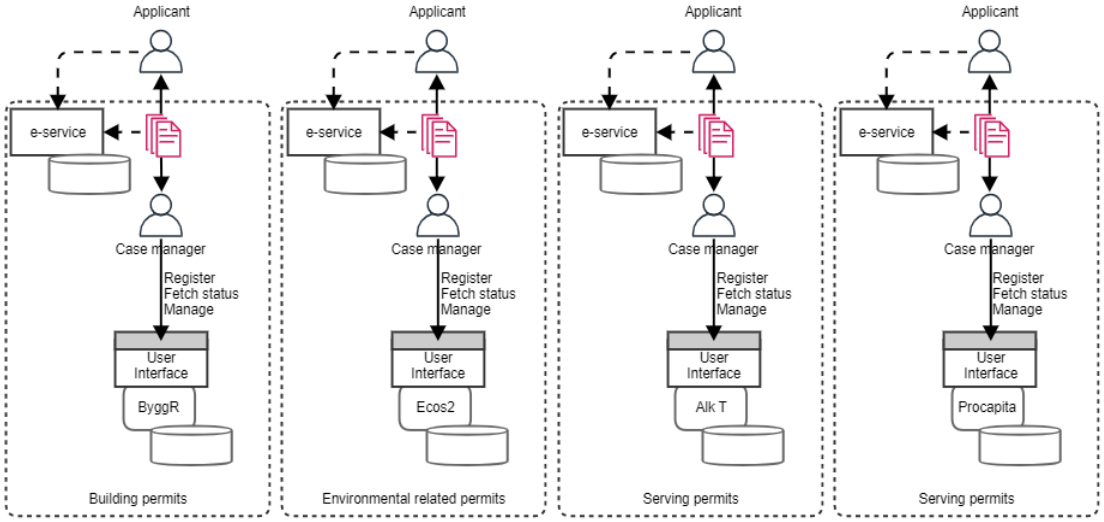

Figure 2. The siloficated case management work practice and siloficated systems

From an architectural perspective, the systems are designed without consideration of the other services the municipality provides. From the standpoint of the specific department, such as the department handling the building permit application, the systems fulfill the needs of the case manager to have a place to store case data digitally. However, the system does not allow citizens and business owners to be users. Furthermore, as each department has its systems that specialize in dealing with specific cases, the result is systems that need to be better integrated or non-integrated. Such problems are also observed in healthcare institutions and referred to as silofication (Øvrelid, 2023).

5.4 Citizens and business owners' perspectives

Analysis of the archival data reveals that citizens do not consider receiving enough support from the information systems. Although case managers can guide citizens during the permit application, citizens hope to get more autonomy. The systems do not consider the specific need of the applicant. A citizen describes the case manager-driven application process like:

"The case manager helped and guided me through the entire process. It felt good with the personal help, it became very clear what I needed to do... you want to be more independent though. You always start there - on the web. I want to be guided there - what applies to me?" Quotes from the Pre-study report: Digitization of the building permit process, translated from Swedish.

Citizens and business owners hope to get tailored guidance during the application for permits. For example, a first-time applicant of building permit and a company applicant of building permit have different needs.

"It came as a surprise that it would be so tricky. I realized after a while that this was more complicated than I thought." Comments from a first-time applier.

"Much in the building permit process is adapted and made for those who cannot. Not adapted for us who apply for it many times. They know we can do this, so why this fuzz every time?" Comments from a frequent applicant. Quoted from the Pre-study report: Digitization of the building permit process, translated from Swedish.

5.5 Possible causes of technical debt, silofication, and missing link with citizens

The above analysis revealed that the municipality has a large, scattered TD of specialized monolithic solutions per one domain, like separate case management solutions for managing building permits, environment related permits, and separate facility management solutions for managing outdoor facilities, land lease facilities, school facilities just to mention a few examples. Each system is

designed from a case manager's perspective, and it is costly and even impossible to integrate the systems into a portal, to provide a seamless experience to citizens.

As the organization's departments work in silos, information systems also work in silos. Interoperability between the organization's systems has not been considered in the design or procurement of the systems. "Conway's Law" states that "*organizations which design systems ... are constrained to produce designs which are copies of the communication structures of these organizations*" (Conway, 1968). Such a phenomenon is also called mirroring, where the information systems mirror the communication structures of the organizations (Colfer and Baldwin, 2016; Øvrelid, 2023).

Forgetting about citizens as users of the systems leads to TD such as requirements debt and architecture debt. The requirements are incomplete because citizens' and business owners' needs are missing from the system requirements. The architecture of the systems is not designed for integration into an overall IT infrastructure that allows for the design of a portal that presents services from different departments and subunits in the municipality. TD becomes salient when the systems are being examined from the perspective of offering citizens and business owners an improved experience of municipality service, in the context of the digital transformation of the municipality, and here the siloficated systems lead to insurmountable challenges. Table 3 synthesizes the possible causes of the TD identified in the municipality systems.

TD Type	Description and Consequences	Possible Causes of the TD
Architecture debt	The system is not properly integrated into the existing IT landscape. Integration is complicated and costly, and only part of the system can be integrated.	The systems are designed for specific departments or specific subunits, for specific permit applications. The systems are not designed for providing services to the citizens. In many cases, the systems are designed mainly for data storage, as a simple tool to help case managers to keep track of case information.
Requirement debt	Requirements are incomplete, which makes it impossible to allow citizens to fully interact with the system. Requirement debt also leads to challenges to integrate the system with other systems. It is thus impossible to support citizens' interaction with the municipality that spans different departments.	Citizens are not considered as users when specifying requirements. Only case managers are considered as users of the system. Each department specifies its own requirements for the system they use, and there is a lack of communication among different departments, a lack of communication between the departments and the municipal IT department. This siloed approach often leads to incomplete system requirements and inadequate consideration of citizen needs and perspectives.
Test debt	There is no test process and proper test phase in place which leads to that integration is not properly regression-tested when the system is upgraded.	Systems are often viewed as static and not designed to evolve. This static view results in a lack of provision for a testing environment or developed testing processes.
Infrastructure debt	Technological development, adjusting to new standards and adjusting to citizens increasing requirements on digital support have not been addressed over time.	Lack of steering from the municipality sector, combined with the vendors' business models that do not promote innovation.

Documentation debt	Parts of the system lack proper documentation.	Documentation debt is closely linked to requirement debt, as the necessary documentation needs are often not properly captured in requirements.
Process debt	The system cannot automate the work process. Instead, case managers drive the work process manually.	Case managers are considered experts in the process, possessing the knowledge and experience to handle case applications. This expertise was not considered necessary to be embedded in the system during its design. Therefore, automation of the process was not considered a relevant issue when the system was designed and procured.
Data debt	Data accessibility, data ownership related issues.	When procuring systems from suppliers, data ownership was not specified in procurement requirements. As long as data can be viewed from the user interface of systems, case managers consider the system to satisfy their needs. Specifically, issues such as whether citizens can access the information or whether the information can be exported are not typically considered during the procurement process.

Table 3. TD identified in the municipality information systems and their causes

6 Discussion

Siloficated work practices and mirrored work practices lead to the dislocation of information systems. For a long time, suppliers of municipal systems built monolithic department-specific systems, where the system design only considered department-specific requirements. Over time, this setup has led to TD with monolithic systems that have not kept up with the technology development, covering only specific organizational needs. As an IT expert pointed out, *"... there is a system error in the municipality sector. It is about how the municipalities have built up their infrastructure around a variety of niche systems. In a normal-sized municipality, between 150 and 200 systems are needed to just keep the municipal task afloat. These systems are developed based on one process: there is a building permit system, a system for applying for an alcohol permit, and another if you are applying for an environmental permit." (Interview: Marcus Matteby).*

The systems are designed from an inside-out perspective, designed for handling internal case management, rather than for citizens to interact with the municipality. This means that the IT architecture consists of rigid monolithic systems that allow limited possibilities for process automation and integration. As a result, it is difficult to meet citizens' pressure on public organizations to keep up with the technological development and present digital services open 7/24 (Lindgren et al., 2019; Mergel et al., 2019).

Surprisingly, the scattered IT architecture is not perceived as a problem in the respective case management departments. The need for digitalization is not well understood since they have their very specific assignments based on the department's assignment as an authority practitioner and not based on how to serve the citizens and business owners in the best way during their complete assignment journey, and they have adjusted their way of working to the system support they got and not on requirements from the citizens and business owners. In some cases, case managers even work completely manually and ask assistants to help with entering the data into specific systems. Case managers perceive their value based on how well they guide the applicants during their application journey through phone calls and emails, not on how an application journey can be designed as efficiently as possible from a citizen's perspective. Such views may explain why the respective case management departments do not recognize TD in their systems.

It would of course have been interesting to also investigate the potential code debt ("the problems found in the source code (poorly written code that violates best coding practices or coding rules) that can negatively affect the legibility of the code making it more difficult to maintain." (Rios et al., 2018)) in the systems and by that be able to estimate the quality and robustness of the systems, but since the code is closed this is not possible. The fact that the code is closed also leads to transparency issues when it comes to what data we are storing regarding our citizens and what algorithms are used when cases are evaluated, and in some cases even decided upon, by the system. It can be argued that this does not follow the regulations of the Swedish principle of public access to official records and parts of GDPR, and raises the question if this could be seen as a transparency debt.

This study is an exploratory case study. As the study is conducted in one municipality, and though the municipality is representative of the municipality sector, it is worthwhile to examine TD more broadly in the municipality sector as well as in other public sectors. Future studies can also examine how citizens are affected by the TD and the silofication of the organization, and how to manage TD. We hope the findings in this study shed light on what TD types are in the municipality sector, the underlying reasons that lead to TD such as silofication and the missing link with citizens, and provide a ground for investigating how to mitigate TD in the public sector.

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