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Generativity Practices in EHR Implementation: A Case Study of the Transition from Design to Usage

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Abstract. This paper explores the concept of socio-technical generativity within the context of a large-scale platformization project in the healthcare sector. Despite generativity being a central topic in the development and evolution of digital platforms, there are few empirical studies on its implications for the practices involved in platformization. This study investigates how the process of generativity changes during the transition from design to use. Our preliminary findings reveal that it is a continuous process that is not limited to the platform's existing affordances and that the controlled top-down practice in design is replaced by parallel ad hoc practices during use. We discuss how shadow systems can be viewed as a breakdown in the generativity process as well as challenges arising from scaling and interconnections. Finally, we emphasize the critical role of management in facilitating generative processes.

Introduction

It is a marathon, and we may have run only 2 of the 42 kilometers.

The quotation above is from an interview we had with one of the leaders in a large-scale digitalization project in municipal healthcare. The two kilometers that the interviewee refers to is the effort spent on the initial customization of the purchased software package –involving more than 400 domain experts – while the remaining 40 kilometers refer to the work that is left to do after the implementation project is over and the software package is put to use. This project, like many modern digitalization projects, combined the acquisition of standardized, packaged, half-built software on the one hand, with the customization of this software to the local needs of the buyer on the other (Pollock et al., 2007).

The preliminary findings from our case study presented in this paper show how the initial customization project – despite its large size, duration, and cost – did not manage to deliver a product that could be used by all the employees in the municipality. As a unit leader in the municipality – whose unit had to use the final software – told us: "The vendor always showed us what was possible to do with the product and not what it could actually do for us right now" and that "what we received at the end was not what we asked for." Paradoxically, another unit leader told us that the customization project had resulted in increased innovation and efficiency in his unit and that his unit continued to innovate on top of the delivered product also after the project was over.

The software product in discussion is an electronic health record (EHR) system aimed at providing a unified health record – and associated workflow support – across primary and secondary healthcare in the central region of Norway. The product is one of the leading EHR systems in the world (Foundation Systems developed by Epic). The platformization project has been ongoing for several years and has recently transitioned from a three-year design phase to daily use (through a so-called go-live event). Studies of EHR implementation in primary (Rahal et al., 2021) and secondary care (Priestman et al., 2018) point to multiple socio-technical challenges related to staff training, the difficulty of changing routines and practices, user involvement, limited resources, etc.

Most EHR systems utilize the so-called platform model where the software is divided into a core and a periphery (Rodon Modol and Eaton, 2021). A digital platform is generally defined as a "software-based product or service that serves as a foundation on which outside parties can build complementary products or services" (Tiwana, 2014, p. 5). The foundation is the core, while the complementary products and services – often developed by the organizations that will use the final product – constitute the periphery. We also define platformization as the "organizational, social, financial and technological transformation that an organization often must go through to effectively utilize a platform model" (Farshchian et al., 2021, p. 2). Due to their broad areas of impact, digital platforms lead to not only a customized product but also to organizational change that, in turn, requires reconfiguration of

the technological base (Leonardi, 2009). Platformization is therefore not a linear process with design following use.

To better understand the process of platformization, in this paper, we use the lens of generativity to interpret our initial findings from a set of observations and interviews. Generativity is defined as "technology's overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences" (Zittrain, 2006, p. 1980). Generativity has recently become a central topic in the development and evolution of platforms (Grisot and Vassilakopoulou, 2013; Msiska and Nielsen, 2018), where it is often regarded as a form of innovation (da Rocha and Pollock, 2019). Generativity is a suitable lens to study platformization processes because these processes often must generate new affordances on top of already established platform cores. Importantly for practice-oriented studies, generativity is increasingly considered a complex socio-technical practice (Grisot and Vassilakopoulou, 2013; Msiska and Nielsen, 2018).

In this paper, we want to explore the concept of socio-technical generativity and its implications for the practices involved in platformization. Our exploration is based on the above-mentioned study of a platformization project in the domain of healthcare. The preliminary data analysis demonstrates several properties of socio-technical generativity.

First, while most research on generativity assumes that generativity is restricted to the affordances provided by the core platform, our data shows that users not only build on these platform affordances but they also introduce new ones that are not based on platform affordances but can be used to extend the core platform. Second, our data show how generativity practices change in the transition from design to use, going from a controlled top-down practice to several parallel and apparently ad hoc practices. Our data also demonstrate challenges related to the scale and the interconnection between generativity practices and their consequences for management. In this way, our paper adds to the body of literature about socio-technical generativity through a case study in progress.

In the rest of the paper, we present relevant literature from digital platforms and generativity, before we present our preliminary findings from our case study and conclude with a discussion and our plans for future research.

Background

This study is based on the literature on digital platforms and digital affordances provided through boundary resources (Tiwana, 2014; Hein et al., 2019). Affordances can be actualized by using the generativity of the platform (Zittrain, 2006; Msiska and Nielsen, 2018).

Affordances in generic digital platforms

Digital platforms are complex socio-technical systems (Lyytinen et al., 2017). The platform architecture consists of a platform core and a periphery (Tiwana, 2014). The platform core is shared across the users of the platform and is often difficult to change (Rodon Modol and Eaton, 2021). The periphery consists of functionality that is developed by the so-called complementors who develop additional components and services on top of the core. The periphery is connected to the core through boundary resources (Ghazawneh and Henfridsson, 2013) such as application programming interfaces (APIs). These are the "generative" parts of the platform ecosystem (Thomas and Tee, 2022) that increase the platform's digital affordances (Hein et al., 2019). Markus and Silver (2008, p. 622) define IT-related affordances as "the possibilities for goal-oriented action afforded to specified user groups by technical objects".

Digital platforms are examples of generic software systems. Such systems are "brought into being through an intricately managed process, involving the broader extension of a particularized software application and, at the same time, the management of the user community attached to that solution" (Pollock et al., 2007, p. 1). The organization that will use the platform needs to take advantage of the generativity of the platform to create its own value-adding complements by actualizing the platform's affordances (Hein et al., 2019). According to Ellingsen and Hertzum (2019, p. 2), this is a challenge because "while configuration makes some functionalities easy to set up, it also restricts the space of possible functionalities to those envisioned by the designers of the configuration facility".

Electronic health record (EHR) systems have been adopting the above core-periphery division to make their solutions more flexible so that users and the vendor can add modules on top of the core functionality (Monteiro et al., 2013). This process involves actors such as system implementors and users working together to configure it for their specific needs. Due to their broad areas of impact, digital platforms lead to organizational change that, in turn, requires reconfiguration of the technological base (Leonardi, 2009). Platformization is therefore not a linear process with design following use.

Generativity

The noun "generativity" is derived from the verb "generate" and denotes the ability to produce or create something (Thomas and Tee, 2022). Generativity was originally a quality attributed by Zittrain (2006) to the internet but has since been applied to discuss deliberate generative platforms like Google, Apple, and Facebook and their ecosystems of complementors (da Rocha and Pollock, 2019).

Zittrain (2006) presents four important criteria for generative technology:

1. Capacity for leverage: The more effort the technology saves, the more generative it is. Technology with good leverage makes difficult jobs easier.

2. Adaptability: Relates to flexibility both in terms of using the technology as it is but also whether it allows changes to be made by its users.

3. Ease of mastery: Refers to how easy it is for the users to understand a technology as well as the effort required to adapt it.

4. Accessibility: How easy it is to use and control the technology, which can be influenced by financial, legal, and secrecy barriers.

Other characteristics that facilitate generativity are modularity, openness, standardization, and incompleteness (Pauli, 2021). Generativity directly relates to a technology's affordances. For a platform, the actualization of affordances through boundary resources leads to generativity (Hein et al., 2019).

Generativity is a socio-technical phenomenon. According to Grisot and Vassilakopoulou (2013), generativity is a key aspect of information infrastructures, and the negotiations between standardized – core – and generative – peripheral – features is a socio-technical process. Similarly, Ansell and Torfing (2021) argue that generativity arises from collaborative interaction between stakeholders to solve problems. They also argue that generativity requires governance "that facilitates and enables the emergence of productive interaction among distributed actors" and define platforms as generative institutions that may support co-creation. Thomas and Tee (2022) conducted a systematic literature review and developed a conceptual framework based on different theoretical perspectives on generativity. They argue that generativity is a "sociotechnical system where social and technical elements interact to facilitate combinatorial innovation, and where generative fit and governance play a central role" (Thomas and Tee, 2022, p. 256).

Despite the socio-technical aspects of generativity, only a few practice-related studies have been conducted to empirically investigate generativity in platforms (Msiska and Nielsen, 2018; da Rocha and Pollock, 2019; Vestues and Knut, 2019). In the following, we will provide a short overview of the findings from these studies.

Msiska and Nielsen (2018) developed the concept of socio-technical generativity in the context of an open-source healthcare platform used in developing countries. They argue that socio-technical generativity consists of two dimensions: social relationships and technology capacities. The attributes of social relationships are aligned directedness, heterogeneity, mutual directedness, appropriate permissions, and action opportunities (Msiska and Nielsen, 2018). The attributes of technology capacities are based on Zittrain (2006)'s four criteria for a generative technology discussed above.

da Rocha and Pollock (2019) investigated the processes of generativity and generification by analyzing data on the relationship between a platform owner and its customer. They found that tight control, boundary resources, and asymmetric relationships did not discourage customers from "a generative venture". In their case, generativity "was fueled by customer necessity of complementing the platform with key functionalities for its operations".

Vestues and Knut (2019) did a case study of a large public service organization going from a silo-based system to modular applications, allowing teams to work

more autonomously. They found that platformization increases generativity within organizations by expanding the available resources and better connecting the resources together. They introduce the concepts of "decoupling" and "recoupling" to describe the process of establishing an appropriate modular architecture to enhance resource density (decoupling) and the process of establishing practices and roles that facilitate resource integration (recoupled into cross-functional teams that perform continuous software development).

Case and method

Case description

In 2022, a healthcare platform called Helseplattformen was implemented in the region of Central Norway. The aim was to replace the different medical record systems used in both primary and secondary healthcare with one common EHR. The vendor of the EHR is the American company, Epic Systems Corporation. The product, hereafter called Epic, was procured in 2019, and a local company called Helseplattformen AS (hereafter called HP) was created. HP is owned by user organizations, i.e., St. Olav hospital which is the largest university hospital in the region, and Trondheim municipality. Other municipalities in the region and primary care actors are joining and taking part-ownership in the company as they join.

The organization of the platformization process is shown in Figure 1. To configure and customize Epic to the Norwegian setting, HP hired tens of *application analysts*. In addition, the role of *subject matter experts (SMEs)* was created. These are domain experts from user organizations who were recruited by HP in 20%, 40%, or 60% positions, to represent their field in the design and implementation process. More than 400 SMEs were hired in primary and secondary healthcare to represent the almost 40 000 healthcare workers in the region. SMEs play a key role in the evolution of the platform which includes providing direction and feedback on their field of work to design the workflows and content, approving the workflows before implementation, participating in testing, and assisting in making the training materials for the end-users.

A third important role is that of *super users* – i.e., selected users who are in charge of training other users post-implementation. There are approximately 900 super users in the municipality of Trondheim. The primary healthcare services in Trondheim municipality consist of more than 80 units with 9000 employees that serve 200 000 citizens.

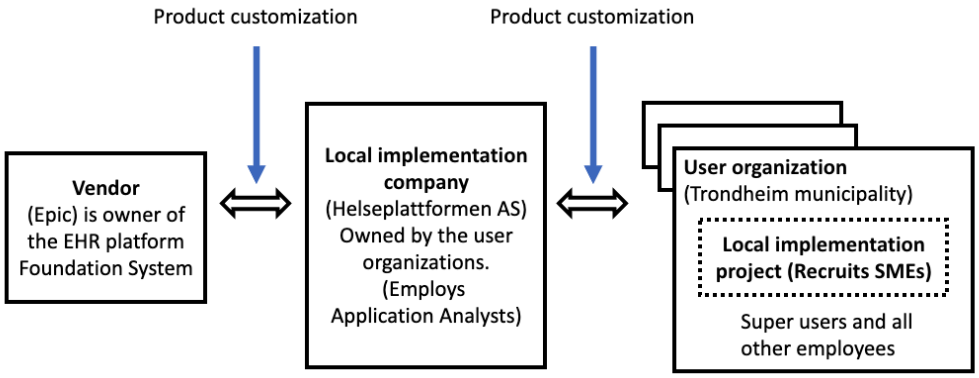

Figure 1. The different actors involved in the platformization project..

The "go-live" date – i.e., the date the customized Epic software is delivered to the user organizations - for primary healthcare in Trondheim municipality was May 7th, 2022, after being postponed twice. The software was simultaneously implemented across all of the over 80 healthcare units within the municipality.

In this study, we visited two different units in the municipality approximately six to eight months after go-live to understand more about how they are using Helseplattformen, how their work practices have changed, and how they are working to optimize the solution and practices.

Interviews were conducted with super users, SMEs, and managers at each unit, as well as managers in the local implementation project (see Table I). One of them manages the SMEs and is referred to as the *champion*.

Unit 1

The first unit that we visited was a front-line coordinative unit that receives inquiries and applications from citizens. The cases that this unit receives are distributed among the caseworkers who process them and make decisions. They work first line together with the Norwegian Labour and Welfare Administration (NAV) and general practitioners (GP). They collaborate closely with NAV and GPs, in addition to the hospital which is second line. In Trondheim municipality, this unit serves as a coordinative unit between the 80 executive units. They are the connecting link between the hospital and primary healthcare. These services also exist in other municipalities in the region, which are often organized differently due to smaller scales. As there was no existing solution for case management in Epic, a new application was built for this unit during the initial implementation project.

Unit 2

The second unit that was visited is a free day service that offers mapping, conversations, follow-up, and guidance for people with psychological challenges.

The application this unit is using was built for the home care units in the municipality, however, it was built with the intention of also being used by this unit. It was therefore customized and not built for them. Unit 2 mostly conducts 1-1 consultations with patients.

Research method

The research strategy is an exploratory case study based on qualitative research methods. Data has been collected over a period of two years; however, this paper focuses on data collected after go-live. Observations were conducted at the different units to get an understanding of their work practice and interviews were conducted with different actors, including SMEs, super users, unit managers, and managers in the local implementation project. Interviews were recorded and transcribed and lasted on average about an hour. Observations were documented using extensive field notes. Observations were not recorded.

A qualitative analysis was performed on the data using NVivo. The first step was to identify codes in the transcriptions and field notes, before dividing them into conceptual categories and identifying patterns. These patterns were used to identify the overall themes.

Table I. Data collection methods.

Method	**Data**
Observation	1 day at Unit 1 (approximately 5 hours) 1 day at Unit 2 (approximately 5 hours)
Interview	2 Super users (primary healthcare) 2 SMEs (primary healthcare) 2 Unit leaders (primary healthcare) 2 Managers (local implementation project in Trondheim municipality)

Findings

In this section, we present our findings concerning the different units, the routines they have created post-go-live, and how they continue to optimize and generate solutions.

Support for optimization and innovation

Prior to the implementation of Helseplattformen, Unit 1 and another unit in the municipality were utilizing a shared calendar within their medical record system to plan patient stays. However, Helseplattformen lacked a similar planning tool, forcing them to devise an alternative solution independent of the platform by creating a shared spreadsheet. They had requested similar functionality within

Helseplattformen well in advance of go-live, yet the SME in the domain remains uncertain as to why the request has not been fulfilled. It is unclear to the SME whether the request is infeasible to configure, too costly, or simply not a priority for Helseplattformen. The SME says regarding the shared spreadsheet that

> They almost have to have a shadow system like that, because the system is simply not good enough. (...) We need a development that I do not think Helseplattformen has the answer to themselves, because they most likely haven't done it before. If they had the answer, they would have done this a long time ago, because we asked for it long before go-live. We told them that this is not going to work

In the same unit, they have made physical boxes with printed inquiries and applications to make sure that none of the incoming cases "go missing" in the system. The overview of pending cases in Helseplattformen was not satisfactory according to one of the super users. A large cardboard box is therefore standing in the middle of their open-plan office space, full of paper folders. Regarding the physical folders of outstanding cases, the SME says that this shadow solution might be due to insufficient training of the users.

According to the SME in the domain, Unit 2 has emerged as the most successful unit within the municipality concerning the implementation of Helseplattformen. This unit has initiated the development of novel functionalities by building on top of an application from Epic and has also identified more effective routines soon after go-live. The SME gives an example of when a super user was playing around in the system and discovered a solution in relation to the patient plan and made this ahead of a scheduled meeting with the patient. This led to the super user only spending one minute to document a visit. According to the SME, this improved routine and efficiency is about the interest of the super user for computers and service development. As mentioned, Unit 2 has also started to develop new services that build on an existing application in the Epic system. It is an application that will notify the patient about necessary forms to fill out and provide various information regarding the treatment that the patient is under.

Approximately eight months after go-live the SMEs' main task is to test different workflows to optimize the routines. They collaborate with SMEs from other units in the municipality on testing and playing around with the system. They do not have access to change anything in the system or in the user interface (they cannot develop or build, only customize their own personal screen). If they find a good way of doing something, they tell the caseworkers at the unit, that "this is how you should do things now". They rarely speak to the application analysts anymore because they are busy with the other municipalities and hospitals in the regions that are going live.

Epic has an impressive dashboard for managers that provides them with a lot of information. Sometimes even too much information. One of the managers mentioned that when she started to use Helseplattformen, the dashboard of the managers was showing a list of the ten best and ten worst employees based on case

handling time. This information was quickly removed from the manager's personal dashboard.

Challenges of large-scale generativity

According to the champion, "personalization of your screen is possible, but if the user wants new tests, navigators, or a new tab with some specific information, they [the different service areas and municipalities] must agree on it." The champion uses the example of video consultation and whether the window should close automatically or not after a consultation has finished. At some units at the hospital, they want it to be manual but that will affect the municipality as well, which is why they need to have a say in it and participate in the discussion. In order to make sure that their data becomes structured the units must coordinate with other units to make sure that they are filling in the same information in the correct fields and that they name the field similarly (for example deciding whether a field is named "sleep" or "sleep quality").

They also need to coordinate with units within the same domain as it is not given that they develop the same workflows. As an example, the offices working on case management should be developing the same routines and practices to ensure that all citizens have the same case management no matter if they live in the south or north part of the city. After go-live, they started to develop different practices, but the SME told the users that the primary objective is compromised if the users operate in a fragmented manner, stating "It is important that we work in the same way. Think the same way". It is particularly important that there is a joint decision if someone wants to remove something because the end-users are not aware of the different applications and how they are connected. It has therefore happened that things have been removed or changed that has made it difficult or impossible for employees at other units to do their job properly. According to the champion, the ones who made this decision had forgotten to think about the ripple effects.

For this reason, they are currently working on a decision-making structure for changes in workflows and other big changes they want to make in the system. Not just for the common solution between the municipality and the hospital, but also because it is a common solution for several municipalities. This is happening eight months after go-live for the municipality and two months after go-live for the hospital.

The leader of the implementation project in the municipality refers to meetings where domain experts from the municipality sat together with domain experts from the hospital. These meetings led to a realization among the hospital wards that "it is actually in the municipality the citizens live". Many citizens are never at the hospital, some are hospitalized for a short period of time, while some are chronic patients and have a greater need for cooperation between healthcare services. The experts' interaction during these meetings facilitated a clearer understanding among hospital wards regarding the workings of the municipality. Additionally, it was mentioned that primary and secondary have different cultures.

A decision-making structure had been created before the project started but the leader of the local implementation project says that "I don't think a single case went all the way to the top. We managed to agree". One of the SMEs also mentions that the municipality has had to accept decisions not because they want to but because it is the right thing to do.

The role of key stakeholders

In the context of Helseplattformen, the champion acts as a boundary spanner who facilitates communication and translation of vocabulary between the users, Helseplattformen, and the vendor. In addition, the municipality has made significant efforts to ensure that their voice is heard during the process of configuration and building. Despite these efforts, the champion reports feeling marginalized and compares their treatment to that of a ward in a hospital. In retrospect, the champion believes that many decisions made 2-3 years ago would have been different if they had possessed the knowledge they have now. Moreover, they received advice to avoid making significant changes immediately after go-live, as it has been observed in other countries that such changes ended up being reversed to the initial solution.

The super users also act as boundary spanners after go-live as they are the ones who know how the system works in use – and not the SMEs. Regarding the SMEs, the leader of the local implementation project mentions that even the work practices have changed during the implementation process in some units. In some cases, they have had to employ new SMEs during the last three years. The leader says

> [New SMEs] come in fresh with, 'yes, but we work like this in 2022. We don't work like we did in 2019'.

The practices of caseworkers have undergone significant changes since 2019 when the SMEs were hired by Helseplattformen AS. However, it is worth noting that the caseworkers themselves have also changed during this period, with a generational shift occurring within one of the units. The manner in which tasks were performed in 2019 is not necessarily representative of current practices in 2022.

During usage of the system, the SMEs play a critical role in continually developing new solutions and optimizing the workflow. The SMEs make decisions on behalf of the employees in their domain, which may also involve other municipalities. According to one SME, this poses a significant challenge, particularly given that they are the only SME within their specific domain. As such, the SME requested two employees, with whom they could collaborate and exchange ideas, specifically people that are not super users. The SME ended up collaborating with two experienced caseworkers on a weekly basis to make decisions and improve the workflow.

The biggest challenge of the implementation according to the leader of the implementation project in the municipality is the changes in work practice and organizational development. Many healthcare workers were under the impression

that they were supposed to receive an updated version of "Gerica" - "Gerica 2.0" - which would involve only minor changes to the screen but would allow them to continue working in the same manner as before go-live. However, the implementation was designed explicitly to facilitate a change in work practices. The system was created to promote a collaborative, cooperative, and different manner of interaction among healthcare workers - necessitating a change in the way of working. The leader of the implementation project says that

> I wasn't completely honest about how difficult it was going to be after we went live (...) Some people thought that as long as we go-live everything would be fine and then three months later I come back and say that this is just the beginning.

It is also mentioned by the leader of the implementation project that

> The municipal director has instilled in us now that it is innovation and constantly reaching for new things that will be the goal. Because you no longer get to a point where 'now we've done it and then we can relax for 2 years'. We are constantly exposed to new challenges.

Discussion

Our preliminary findings are in line with earlier studies that depict generativity as a complex socio-technical process. Our data also show that generativity happens at several layers ranging from individual personalization to organizational decision-making. In the municipality, there are generative communities that are developing generative processes, but the technology is not generative enough to support local differences at the level of units in the municipality. The different processes happening in the two units are both important for generativity.

Types of generativity

Much of the literature on generativity assumes that generativity is bounded by what is already built in the platform core and supported by its boundary resources. This type of supported generativity from the vendor is what we have seen in the initial platformization project when the platform was configured and adapted to user requirements. During use, however, we observe several examples that can be regarded as unsupported generativity.

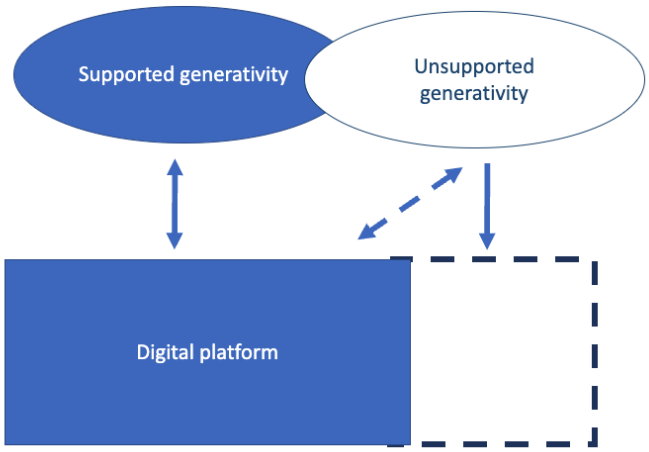

Figure 2. Generativity is based on the affordances provided by the platform..

The situation is depicted in Figure 2, which shows how some generativity is based on the affordances provided through the platform's generic attributes, but others are solutions built outside of the platform due to a lack of affordances. One of the shadow systems that were created by the end-users at Unit 1 can be regarded as an example of unsupported generativity where "plan-ability" is not afforded by the platform (Hausvik and Thapa, 2017). One can argue that these shadow systems would not have been developed if the platform was not introduced in the first place. In this way, we propose that they are examples of unsupported generativity that need to be considered in further development of the platform. Table II shows an overview of the generated artefacts that were either supported or not supported by Epic.

Table II. Overview of generated artefacts at the different units..

	Supported generativity	**Unsupported generativity**
Generated artefacts	• Personalization of dashboard for managers (Unit 1 and 2) • Care companion app (Unit 2) • "Build" for mobile application (Unit 2)	• Shared spreadsheet (Unit 1) • Physical boxes (Unit 1)

When considering the different kinds of generativity, it is important to investigate the underlying conceptual model used in the platform core. The Epic system was initially developed for hospital usage, specifically designed for one-on-one consultations – as done in Unit 2. However, this approach may not be appropriate for the coordination among numerous actors which is largely what the municipal healthcare system in Norway is based on. In response, shadow systems have been developed more frequently in Unit 1, which primarily focuses on coordination.

The shadow systems that were created in Unit 1 – i.e., the unsupported generativity - can be seen as a form of breakdown in the generativity process. Or it can be seen as an idea for design and an opportunity for platform innovation. From a supported generativity perspective, the creation of the shared spreadsheet can be interpreted as a breakdown because the missing functionality was already requested prior to go-live, according to the SME. It is also not clear why the request was not complied with, which further supports the notion that it is a breakdown. Such incompleteness of a generic platform can lead to generativity, which in turn can be generified (da Rocha and Pollock, 2019). This example is also in line with Vassilakopoulou and Grisot (2012)'s understanding of generativity, which emphasizes actors' knowledge, skills, and creativity in producing unanticipated outcomes. The creation of unexpected change is nevertheless governed by the platform vendor. Regarding the physical box of outstanding cases, it is more likely that this shadow system is caused by a lack of training or exploration than technological restrictions. According to the SME, the functionality needed to filter cases is already available in the system. Either way, the system does not afford the necessary possibility of action.

Transition from design to use

Our data demonstrate a significant shift in the processes that support generativity in the municipality, from design – pre-go-live – to use – post-go-live. During the design phase, the implementation process was a formal waterfall process controlled by the vendor (Ringdal and Farshchian, 2022). However, during use, the process went from a top-down, centralized management approach, to a bottom-up, decentralized approach which proved to be challenging (see Figure 3). Users who had participated in the vendor-led generativity process were required to take charge of the generativity process themselves, while simultaneously attempting to incorporate the technology into their real-world practices for the first time. This user-controlled process post-go-live has resulted in the development of shadow systems.

There are several reasons why there might be a lack of support for generativity during use. One explanation, in our view, is the way platformization projects are planned, i.e., typically using waterfall models with contractual handovers. Furthermore, due to issues that emerged during another go-live event at the hospital, the vendor and HP staff were unavailable to Units 1 and 2. Additionally, the incompatible models in technology and practice that are not uncovered before the system is in use lead to further difficulties.

Although there has been a shift in the process, the vendor and HP continue to maintain firm control, as all development and customization must go through them. Furthermore, the application analysts who possess the knowledge and access to configure the system are not as available as they were prior to go-live. Despite the leader saying that the real work starts after go-live, the process is increasingly led

by the users, restricting the opportunities for change and evolution on top of the platform.

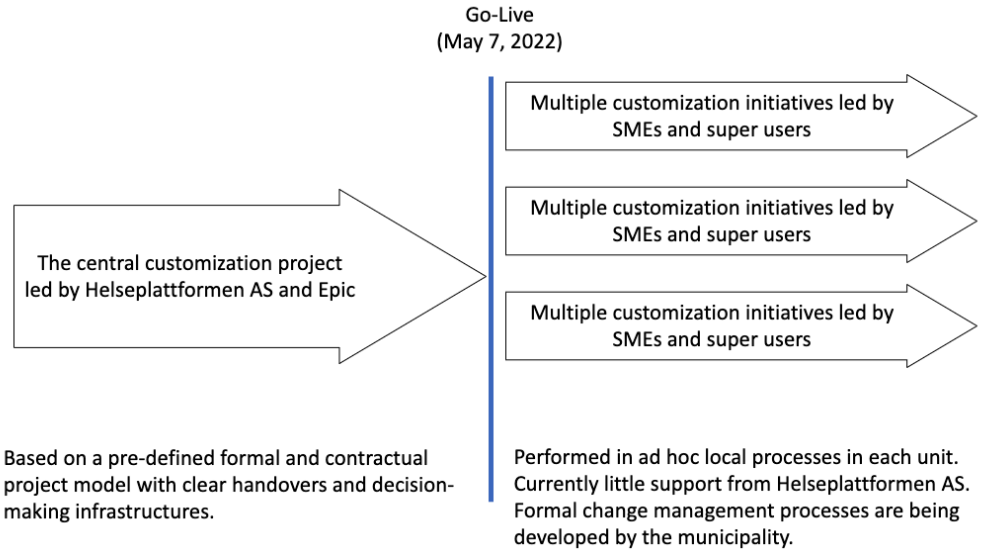

Figure 3. Change in the generativity processes from design to use..

Scale and interconnections

Due to the large number of user organizations sharing the same platform core, changes made in one unit in the municipality may have unforeseen effects in the hospital, or in other entities in the community, and/or other communities. The consequences of changes can be unknown to end users, super users, and even SMEs. Development and configuration requests are sent to the vendor and the application analysts. However, these are often busy with urgent tasks.

Even though Helseplattformen is flexible in terms of opportunities for customization, SMEs and end users are only able to personalize their private screen and generate new work practices and workflows based on the system they have (appropriate permissions). This is a collaborative task now that the units in the municipality and the hospital are more tightly coupled. The continuous development practices in the municipality are currently being organized and recoupled (Vestues and Knut, 2019). We are seeing that the user services are not necessarily congruent with the working practices of the clinicians.

Managing generativity

Creating opportunities for generativity requires continuous involvement and support from the management. Managers need to prioritize and allocate resources in terms of staff such as super users. In addition, managers need to have processes in place to promote a culture of generativity by e.g., promoting the idea of continuous improvement.

It is emphasized by several interviewees in different roles that the unit manager's role affects the facilitation of the change process. Many employees were expecting their work practices would remain the same even if a new platform was being produced. The process of implementing an EHR system is, however, not merely technical. As emphasized by the interviewees, going from a medical record system that is unstructured and based on free text to a standardized, rule-based system is a major organizational change project.

Facilitating such changes place great demands on the management at different levels. The data indicates that having the platformization project on the agenda and discussing the new system in employee meetings for more than a year before go-live was important to prepare the employees for what was coming. Improving the employees' general computer skills and redeeming super users for an extended period have also been mentioned as important measures.

It has been communicated through the whole implementation process that the benefits of implementing a common EHR are many. But it is up to the users to figure out how a new system and work practice can help them realize these benefits. According to the leader of the implementation project, it was not made clear pre-go-live that this will be a process of continuous development. There is a need for a culture of change, which is challenging in a sector characterized by complexity and intricate integration between technology and practice. However, there is a strong need for innovation in the healthcare sector.

Conclusion

Through a preliminary study of how an EHR is being implemented in a large municipality, we have shown that generativity is not limited to the design phase but is even more important when the generative platform is in daily use. Our data show that it is important to look at the breakdowns in usage not only as negative but as indications of how the platform can be improved (or organizations can be changed). Breakdowns can be more valuable sources of innovation than the pre-defined acts of generativity that are put there by the owners of the platform. The creation of shadow systems can have a generative role and the role of the management is to facilitate a culture of change. Generativity is to increase flexibility, but it is complicated in a complex context and system like a large-scale EHR system.

Future research can build on these preliminary findings to further explore the generative mechanisms of shadow systems. A recent study by Bartelheimer et al. (2023), explore the role of workarounds as a generative mechanism for bottom-up process innovation in organisations and argue that the complex process of workaround diffusion needs to be investigated further. Literature on infrastructuring could potentially provide an interesting lens to explore such generative mechanisms. The responsibilities of managers and the challenges they encounter should also be explored in much greater depth to to gain a deeper understanding of socio-technical generativity within organizations.

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References

Ansell, C. and J. Torfing (2021): 'Co-creation: The new kid on the block in public governance'. *Policy & Politics*, vol. 49, no. 2, pp. 211–230.

Bartelheimer, C., V. Wolf, and D. Beverungen (2023): 'Workarounds as generative mechanisms for bottom-up process innovation—Insights from a multiple case study'. *Information Systems Journal*, pp. 1–66.

da Rocha, F. N. and N. Pollock (2019): 'Innovating in Digital Platforms: An Integrative Approach.'. In: *ICEIS (2)*. pp. 505–515.

Ellingsen, G. and M. Hertzum (2019): 'User participation in the implementation of large-scale suite systems in healthcare'. In: *Proceedings of the 7th International Conference on Infrastructures in Healthcare 2019*.

Farshchian, B. A., M. Grisot, S. Hochwarter, A. Sigríður Islind, M. Mikalsen, E. Parmiggiani, and P. Vassilakopoulou (2021): 'Platform-Supported Cooperative Work'. In: *Proceedings of 19th European Conference on Computer-Supported Cooperative Work*.

Ghazawneh, A. and O. Henfridsson (2013): 'Balancing platform control and external contribution in third-party development: the boundary resources model'. *Information systems journal*, vol. 23, no. 2, pp. 173–192.

Grisot, M. and P. Vassilakopoulou (2013): 'Infrastructures in healthcare: The interplay between generativity and standardization'. *International Journal of Medical Informatics*, vol. 82, no. 5, pp. e170–e179.

Hausvik, G. I. and D. Thapa (2017): '" What You See is Not What You Get"-Challenges in Actualization of EHR Affordances.'. In: *Proceedings of the 38th International Conference on Information Systems (ICIS)*.

Hein, A., D. Soto Setzke, S. Hermes, and J. Weking (2019): 'The influence of digital affordances and generativity on digital platform leadership'. In: *Proceedings of the 40th International Conference on Information Systems (ICIS)*.

Leonardi, P. M. (2009): 'Crossing the implementation line: The mutual constitution of technology and organizing across development and use activities'. *Communication Theory*, vol. 19, no. 3, pp. 278–310.

Lyytinen, K., C. Sørensen, and D. Tilson (2017): 'Generativity in digital infrastructures: A research note'. In: *The Routledge companion to management information systems*. Routledge, pp. 253–275.

Markus, M. L. and M. S. Silver (2008): 'A foundation for the study of IT effects: A new look at DeSanctis and Poole's concepts of structural features and spirit'. *Journal of the Association for Information systems*, vol. 9, no. 10, pp. 5.

Monteiro, E., N. Pollock, O. Hanseth, and R. Williams (2013): 'From artefacts to infrastructures'. *Computer supported cooperative work (CSCW)*, vol. 22, pp. 575–607.

Msiska, B. and P. Nielsen (2018): 'Innovation in the fringes of software ecosystems: the role of socio-technical generativity'. *Information Technology for Development*, vol. 24, no. 2, pp. 398–421.

Pauli, T. (2021): 'Pins on the Map: Navigating the Ambiguous Landscape of Generativity in Digital Platform Ecosystems'. In: *The Role of e-Business during the Time of Grand Challenges: 19th Workshop on e-Business, WeB 2020, Virtual Event, December 12, 2020, Revised Selected Papers*. pp. 75–88.

Pollock, N., R. Williams, and L. D'Adderio (2007): 'Global software and its provenance: generification work in the production of organizational software packages'. *Social studies of science*, vol. 37, no. 2, pp. 254–280.

Priestman, W., S. Sridharan, H. Vigne, R. Collins, L. Seamer, and N. J. Sebire (2018): 'What to expect from electronic patient record system implementation: lessons learned from published evidence'. *Journal of Innovation in Health Informatics*, vol. 25, no. 2, pp. 92–104.

Rahal, R. M., J. Mercer, C. Kuziemsky, and S. Yaya (2021): 'Factors affecting the mature use of electronic medical records by primary care physicians: a systematic review'. *BMC Medical Informatics and Decision Making*, vol. 21, pp. 1–15.

Ringdal, N. O. and B. A. Farshchian (2022): 'The Role of Boundary Objects in Platformization Practices: A Case Study of Software Testing'. In: *Proceedings of 20th European Conference on Computer-Supported Cooperative Work*.

Rodon Modol, J. and B. Eaton (2021): 'Digital infrastructure evolution as generative entrenchment: The formation of a core–periphery structure'. *Journal of Information Technology*, vol. 36, no. 4, pp. 342–364.

Thomas, L. D. and R. Tee (2022): 'Generativity: A systematic review and conceptual framework'. *International Journal of Management Reviews*, vol. 24, no. 2, pp. 255–278.

Tiwana, A. (2014): *Platform Ecosystems: Aligning Architecture, Governance, and Strategy*. Morgan Kaufmann.

Vassilakopoulou, P. and M. Grisot (2012): 'Technology Innovation in the Face of Uncertainty: The Case of'My Health Record". In: *ECIS 2012 Proceedings*.

Vestues, K. and R. Knut (2019): 'Making digital infrastructures more generative through platformization and platform-driven software development: an explorative case study'. In: *10th Scandinavian Conference on Information Systems (SCIS)*.

Zittrain, J. L. (2006): 'The Generative Internet'. *Harvard Law Review*, vol. 119, pp. 1974–2040.