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# Between overexploitation and underexploitation of digital opportunities – a case study with focus on affordances and constraints

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**Abstract.** Several policies for e-government, both on national and supranational levels, express visions and claims for more advanced exploitation of digital opportunities. The paper contributes through a problematization of the idea of utilizing digital opportunities and a conceptualization of this into the polarity of overexploitation vs. underexploitation of digital opportunities. It is based on a qualitative and diagnostic case study on the digitalization of medical certificates and theoretically informed by affordance theory and activity theory. Digital arrangements in the case study are investigated and different types of digital affordances and constraints are revealed. There are examples of surplus of affordances (i.e. overexploitation), lack of affordances and affordances with embedded constraints (i.e. underexploitation), and useful affordances (i.e. adequate exploitation). The application of the affordance and constraint concepts is, in the paper, done through a two-step staging: 1) General characteristics of digital technology give affordances for design. 2) The resulting digital artifacts will have different properties and these properties give affordances but also constraints for use. The resulting conceptualizations are discussed in relation to normative, regulative and other institutional aspects concerning digitalization in the public sector. This is conceptualized in a graphical model describing policy and other pre-conditions, designed digital artifacts, and workpractice effects.

**Keywords:** E-government, affordance, constraint, policy, digital opportunity.

## 1 Introduction

There is a strong claim, among both practitioners and scholars, for increased exploitation of digital opportunities in public administration. In policy planning for e-government development, there exist visions and claims for better utilization of opportunities that digital technology offers. This can be seen in policy documents both on national and supranational levels. There exist several EU policy documents that argue for more advanced exploitation of digital opportunities such as the Tallinn Declaration that states “we are yet to seize the full potential of the digital transformation in our administrations as well as at the EU level” [9]. Another policy document argues for “embracing creative disruption from technology ... packaged in new digital gov-

ernment offerings” [7] as an important design principle for overcoming barriers of innovation in public administration. One policy example on the national level is the national agenda for digitalization in the public sector of Sweden. There is an enounced objective to reach e-government of world-class: “Sweden should be best in the world at using the opportunities of digitalization.” [36]. This objective, originally formulated in 2011, has recurrently been expressed in several policy reports; e.g. [37]. There is a clear competitive reasoning behind this vision; to be one of the best. The recurring benchmarks of e-government maturity [1] seem to be a driver for this kind of thinking. There exist international benchmarks such as the United Nation’s e-Government Development Index [39] and the European Commission’s eGovernment Benchmark [8].

In the scholarly literature, there exist several proposals for stage models [e.g. 22, 25, 26] of egov evolution. These models describe stages of different maturity layers, where more advanced layers are presumed to be better. However, as noted [4], “these stages ... do in fact mainly assume that the level of technological sophistication can be an indicator of success”.

This paper addresses this issue of exploitation of digital opportunities in e-government. The main inquiry question is: *In what ways are digital opportunities utilized?* This is based on a knowledge interest in relationships between digital policies and digital realizations. This is an area that is considered as under-researched [4, 21]. The paper contributes to this discourse through a problematization of the idea of utilizing digital opportunities and a conceptualization of this into the polarity of over-exploitation vs. underexploitation of digital opportunities. It does so, empirically informed by a qualitative and diagnostic case study on the digitalization of medical certificates and theoretically informed by affordance theory [11] and activity theory [24, 43].

## 2 Research approach

This presented research is a “slice” of a larger research endeavor on the governance of multi-organizational digital artifacts in public administration. A research team has studied the relations between different policies and the realization and use of digital artifacts. Several qualitative case studies have been conducted. In the first stage of the research, eight case studies were conducted in parallel. In a later stage of research, another case study was performed based on results from the previous empirical studies. The case studies were based on a general research interest in relations and possible tensions between a policy level and the actual artifact level [14]. The focus was on complex multi-organizational digital artifacts in the public sector [18].

The presented research is based on the last case study. Several purposes guided this specific case study on the digitalization of medical certificates. It aimed at 1) an evaluation of the digitalization of medical certificates (primary target group: those responsible for these digital artifacts), 2) an application and assessment of a multi-dimensional evaluation approach with digital medical certificates as the evaluation object (target groups: scholars and practitioners interested in methods for evaluation

of digital artifacts), and 3) abstracted (case study-based) knowledge on complex multi-organizational digital artifacts in the public sector (target groups: scholars and practitioners interested in policies and the realization of digital artifacts in the public sector). The sliced research presented in this paper is part of the third purpose.

The case study research was conducted through a continual alternation between 1) an empirical and diagnostic inquiry of digital medical certificates and 2) theorizing with qualitative data analysis, reflection, and abstraction [13, 41]. In the empirical part, we mainly used the following methods for collection/generation of data: Interviewing and workshops with knowledgeable practitioners, document studies, and inspections and explorations of the focused digital artifacts [15, 31]. In these studies of digital artifacts, we acted as potential users and collected empirical data concerning digital functionality, interactivity, and information. Screenshots were generated and also annotated with comments on critical concerns. We used a multi-dimensional evaluation approach that guided an alternating focus on dimensions such as stakeholders, digital work processes, digital functionality, digitalized information, digital interaction, interoperability in digital landscapes, goals and values, and laws and regulations [18]. The generation and analysis of data were initially performed in an inductive manner close to the ideals of grounded theory [3]. We aimed at discovery of new knowledge rather than driven by certain hypotheses. This quest for discovery and novel knowledge comprised an open-minded approach in data generation (in order to *see new things*) and data analysis (in order to *create a new understanding*) through interpretation and abstraction leading to new categories [17].

However, the generation and analysis data were not conducted by the researchers as “blank slates”. The evaluation approach with its different dimensions and concepts guided the generation and analysis of data. This means that this type of pre-understanding had an influence on the knowledge development process [17]. Later in the data analysis and abstraction process, new categories and conjectures emerged. For this presented slice of research, the inquiry question was formulated: *In what ways are digital opportunities utilized?* The formulation of this inquiry question was based on 1) findings and insights from the case study and 2) our general knowledge interest on the potential influence from policies with an aim to “maximize” the utilization of digital opportunities (see discussion in Section 1). The formulation of this inquiry question was guided by an identified problematic situation in the empirical practice and not by spotting gaps in the literature [3, 6, 40]. Based on these emergent insights and the formulated inquiry question, the analysis turned from an inductive to an abductive manner [16, 38, 40]. Appropriate theoretical assistance was sought for. Through previous acquaintance with affordance theory [12], this theory was found suitable as a theoretical lens for further analysis. Further theorizing was conducted partially as a problematization of the dictum of maximizing the utilization of digital opportunities. “The more – the better” can be challenged. Affordance theory was found useful for this further theorizing. Through a conceptual analysis of affordance theory, a need was found to complement this through the addition of views from activity theory.

### 3 Theoretical lens: Affordance theory and activity theory

Affordance theory was originally formulated by Gibson [11]. It is considered as an ecological theory of perception. The main idea is that the environment of humans (and other species) is perceived in terms of *what it affords for action*. This means that affordances are properties of the environment in relation to actors. They are not just physical properties of things. The difference between affordances and pure physical properties is described by Gibson [11, p 127]. A floor is stand-on-able, walk-on-able and run-over-able when recognizing what it affords. These affordances are of course based on certain physical properties (e.g. the floor being horizontal, flat, extended and rigid).

However, affordances should not be seen as subjective or mental constructs as Gibson emphasizes. The affordances are in the external objects – but these properties are relational properties, i.e. they exist in relation to an observer/actor. “These positive and negative affordances are properties of things taken with reference to an observer but not properties of the experiences of the observer” [11, p 137].

Affordance theory has attracted interest in information systems research. This comprises both issues of human-computer interaction [e.g. 12, 19, 20, 30, 32] and broader IS issues [e.g. 20, 22, 27, 35]. The general view of affordances in digital technology is that *digitalized artifacts have properties that are relational to their users* and that these properties *provide (=afford) action possibilities to the user*. Affordances need to be both *informative* (visible and understandable) and *operational* (accessible and executable) to the user; see [12, 19]. This paper leans more to the HCI tradition [12, 19, 30] of employment of the affordance notion than the broader IS orientation. This follows from the close empirical investigation of the digital artifacts’ functionality and interactivity as mentioned in section 2 above [15, 31].

According to Gibson [11], there exist also negative affordances. These are properties in the environment that can be seen as aggravating or preventing actions. To consider an affordance as negative can, however, be seen as confusing. This terminological problem has been discussed by [42, 45]. Volkoff & Strong [42] express this conceptual and terminological issue in the following way: “A different question relates to whether affordances can be both enabling and constraining, or whether affordances are only enabling, and constraints are different.” Zammuto et al. [45 p 752] argue for an inclusive notion of affordance covering both positive and constraining functions: “An affordance perspective recognizes how the materiality of an object favors, shapes, or invites, and at the same time constrains, a set of specific uses.” A way to dig deeper into this conceptual/terminological controversy is to turn to etymology. The etymological meaning of the word “afford”, coming from the Middle English word “aforth”, is “to put forth, contribute; further, advance” (Online Etymology). A lexical definition of “further” is “to help the progress of something so that it is more likely to be successful” (MacMillan Dictionary). Based on these etymological and lexical definitions, a “negative affordance” seems to be close to a self-contradiction. Conceptually, there is thus a need for a theoretical complement to affordance theory.

Activity theory can contribute to such distinctions through its concept of mediated action [43]. Within this theoretical tradition, Kuutti [24] emphasizes that “the tool is

at the same time both enabling and limiting”. This means that tools (like digital artifacts) have properties that afford/enable actions but also properties that constrain and sometimes prevent actions. All such artifact properties have the function of mediating/directing actions in certain ways. The key theoretical concept of affordance is thus here complemented with the concepts of constraint and prevention. These different concepts are used, and thus illustrated, in the theoretical reasoning on findings from the performed case study (section 5 below).

#### **4 Case study description: digitalization of medical certificates**

The case study covers digital artifacts related to doctors’ issuing of medical certificates and the transfer of those certificates to patients, their employers and the Social Insurance Agency (SIA), that manages sickness benefit cases. A medical certificate, issued by a doctor, is needed by citizens/employees to prove a legitimate sickness leave to the employer and to SIA. There exist several related digital artifacts in this digital landscape of medical certificates and sickness management. DigCert is a healthcare system containing digital support for issuing, storage and transfer of certificates. MyCert is a module in the national health portal where each citizen/patient can manage his/her medical certificates. One possibility is to print the certificate for delivery to the employer. There exist several digital artifacts at SIA; one e-service for patients’ submission of sickness benefit applications and an internal case handling system for sickness benefits.

Before the digitalization, the medical certificates were issued using paper forms. This form was provided by the Social Insurance Agency to healthcare organizations. The doctor handed over the issued medical certificate to the patient who was responsible to distribute it (or copies) to the employer and to SIA. There are still some doctors that use this old form and procedure.

When investigating the digital solution, we found that there were three different ways to transfer the digital medical certificate from healthcare to SIA for their case handling. 1) Since there exist restrictive privacy regulations in Sweden, it was not permitted for healthcare to just distribute the medical certificate to SIA. An explicit consent from the patient was needed. If this was given and then recorded by the doctor in DigCert, the issued medical certificate could be transferred digitally to SIA. 2) Another way to transfer the certificate digitally was by the patient through the use of MyCert. After selecting a specific certificate in the web application, the patient can initiate a digital transfer to SIA. 3) The first two weeks of sick leave are paid by the employer. After this period, the patient/employee needs to apply to SIA for sickness benefits. This can be done digitally by the patient through SIA:s e-service. In this application process, the medical certificate can be digitally retrieved from DigCert and attached to the application.

The case handling process of sickness benefits at SIA is substantially facilitated by receiving the medical certificate in a digital format. This was a strong motivating force in the design of digital solutions. Therefore, these three alternative ways of digital transfer were designed and implemented. However, these digital solutions have

given dysfunctional effects. These three digital transfer solutions are built on different communication logics. The first two are based on a push-logic. In these situations, the medical certificates are digitally pushed from the healthcare organization to SIA before any sickness benefits application is submitted. If the patient/employee gets well during the first two weeks, there is no need to submit any benefits application to SIA. In these situations, SIA receives medical certificates that have no function for their case handling. However, they cannot just throw them away. According to regulations, SIA must open a case and try to reach the health insured/patient and ask for a sickness benefits application. This is a totally unnecessary administration that costs time and money. The third situation builds on a pull-logic. The digital medical certificate is submitted together with a sickness benefits application.

One important element in the digitalization of medical certificates was the introduction of a decision support in the DigCert's digital service for doctors issuing of certificates. This is a health-insurance decision support containing a repository of medical diagnoses and recommended periods of sick leave for each diagnosis. These standards guide the doctor to select an appropriate sickness leave period. If the doctor issues a period that deviates from the standard period, the doctor is prompted by the digital service to motivate such a deviation.

## 5 Findings and discussion

### 5.1 Overexploitation vs. underexploitation of digital opportunities

In the analysis of this case, it was discovered that some parts of the digital artifacts could be characterized as *overexploitation* of digital opportunities, while others could be seen as *underexploitation* of such opportunities. These categories were generated through a cross-data analysis, which is an analysis tactic of grounded theory [3]. Through a "constant comparison" of different data items and generated categories looking for similarities and differences, new categories can emerge. What is here called overexploited and underexploited digital opportunities are ascribed features of digital artifacts. They are characterized as such in relation to (policy) expectations on digital artifacts. The artifact features were thus seen in relation to pre-conditional policy formulations, such as visions for "world-class" utilization of digital opportunities as expressed in national digital agendas [36, 37]. However, these characterizations were also made through an assessment of the effects of the artifact features. The identification of dysfunctional effects influenced the way these features were conceived of and thus that they were characterized as a deviation from an appropriate exploitation of digital opportunities. A contextual analysis was thus necessary to formulate these categories of overexploited and underexploited digital opportunities, i.e. looking "backward" to policy pre-conditions and "forward" to effects in the digitalized workpractice.

Overexploitation means that a quest to exploit digital opportunities can sometimes be pushed too far. One such example is the design of three variants of digital transfer processes of the medical certificate from healthcare to the Social Insurance Agency. This means identifying opportunities with digital technologies and then exaggerating

the use of such opportunities. Three alternative ways of transfer were designed to ensure that SIA receives the medical certificate in a digital format. As described above (in the case study description, Section 4), these alternative transfer ways had dysfunctional effects.

The case shows several examples of the contrary, i.e. what is here called digital underexploitation. A retained form thinking is one such example. The earlier paper form for medical certificates has heavily influenced the interaction design of a digital certificate form. This has meant a lack of communicative renewal. The digital form for issuing a medical certificate is lacking in precision and clarity (e.g. insufficient explanations, contradictions, unnecessary linguistic variation, work-language imperfections). Another example of such a digital underexploitation is that digital communication has been optimized to one stakeholder/recipient (SIA). There is a lack of adaptation of communication to other recipients (the patient and the employer). This comprises 1) information content not adapted (through information deficiencies and information surpluses) to different recipients and 2) a lack of seamless digital transfer to employers.

The case shows also examples of *adequate exploitation of digital opportunities*. One such example is the introduction of the health-insurance decision support with standardized sickness leave periods. The designers have here utilized the possibility to embed a digital repository into the issuing service of medical certificates. This decision support/repository can be continually updated with changed health-insurance considerations and it is well integrated into the certificate service with a digital retrieval function that is easy for the doctors to manage.

## 5.2 Affordances, constraints and other pre-conditions for design and use

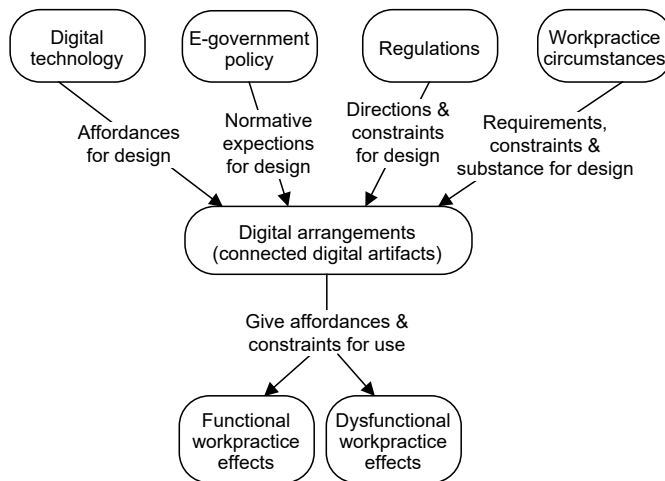
Digital technology affords generally different opportunities, such as programmability and digitization of information with efficient capture, storage, processing, transfer and presentation of such information [44]. These features give *affordances for design*. However, the design of digital artifacts in workpractices (such as handling of medical certificates) is influenced by many other circumstances. There are digital policies with appeals to more fully exploit digital opportunities. There are also specific needs and different circumstances in the actual workpractice that influence the design (issues concerning healthcare, employment, and health-insurance). The workpractice situation of medical certificates management frames the design of digital artifacts. The main requirements for the digital design are obtained from conceptions of objectives, problems, and work-processes in these workpractices. The substance for the digital design (as values, stakeholder roles, work-language, procedures) emanates from the related practices of healthcare and health-insurance. One important concern in this case (as in most other egov areas) is the regulative background of extant legislation [2, 23]. It is said that there exist more than Swedish 70 laws/statutes that have relevance for medical certificates. Digital design is thus a choice of what kind of digital opportunities to utilize [10].

The design outcome will be an amalgamation of these different affordances, constraints and other pre-conditions (Figure 1). The designed digital artifacts (as a net-



worked digital arrangement) with different properties give *affordances for use in workpractice contexts*. Some of the characteristics of the designed digital artifacts do, however, not provide any desired action possibilities. In this actual case there exist:

1. A surplus of affordances, as three ways of digital transfer of certificates that give dysfunctional effects such as unnecessary excess work.
2. Affordances with embedded constraints, as unclear instructions in the certificate form that entail risks for incomplete or deficient medical certificates.
3. A lack of affordances, as no adaptation to employers that may generate extra work for patients and also intrude patient/employee privacy.
4. Useful affordances, as the use of the health-insurance decision support for guidance to set adequate sick leave periods.



**Fig. 1.** Pre-conditions for digital design and digital arrangements as pre-conditions for work-practice use and effects.

A main formulated category, based on this case study, is *degree of digital exploitation*. This is an attributive construct as being a property class of digital arrangements. The degree of digital exploitation, as described above, varies between overexploited digital opportunity (1), adequately exploited digital opportunity (4), and underexploited digital opportunity (2, 3). What has been clear through this case study is the necessity to analyze these kinds of phenomena relationally; i.e. both to antecedents and to consequences. The digital arrangement with its properties (affordances, constraints, and lack of affordances) are *pre-conditions* for digital use in workpractices. They are also "*post-conditions*"; in this case, results of design practices. Obviously, there are important differences between the separate design practices leading to the different kinds of digital properties. In (1) and (4), an *exploitive strategy* has been applied implying a design where digital opportunities were utilized to create something novel in the practices of medical certificate management. In (1), the design has given full priority to the objective to have medical certificates in digital format while neglecting other consequences. Three different ways were designed in order to ensure medical

certificates in digital format. The other two (2, 3) are results from a *conversion strategy*, where features of previous paper-based practices are sustained.

The application of the affordance concept is, in this analysis, done through a two-step staging: 1) General characteristics of digital technology give *affordances for design*. Different digital options of a general character can be utilized in designing and such digital opportunities can be utilized in different ways and degrees. The implemented egov artifacts for use are results of diverse design practices where digital opportunities have been exploited differently. 2) The resulting digital artifacts will have different properties and these properties give *affordances but also constraints for use*. Digital properties will not only enable actions but they also direct, constrain and prevent different actions following the synthesized view of affordance theory and activity theory (Section 3). Such digital affordances and constraints will thus influence the actions of different users/stakeholders.

The model in Figure 1 is influenced by the policy/design/effect (PDE) model [14]. The PDE model describes efficacy linkages from policy expectations (P) to the designing activities leading to designed artifacts (D) and further to the use of these artifacts and subsequent effects (E). In the new model (figure 1), an expansion has been made to include other aspects than only a policy influence as in the original model. Policy was already, in the PDE model [14], given a broad interpretation covering policy statements, values and regulations (as legally codified values). However, in this new and enhanced model other aspects are included as influencing design processes: General properties of digital technology that give affordances for design and the specific subject matter of addressed workpractices that frames the design process. This enhanced model could still be called PDE model, but with another elucidation: "Pre-conditions/Design/Effects".

Related thinking about egov evolution can be found in the Technology Enactment Model [10] and variants/modifications of this [5, 28]. The institutional character of 1) governmental activities and 2) the use of egov artifacts is emphasized in these models. This applies also to the enhanced PDE model. There are, however, some important differences that need to be noted. In Technology Enactment Model, there is a differentiation between objective technology and enacted technology. Enacted technology is considered as the, by its users, appropriated digital artifact; i.e. what it is actually used for, following the theoretical views from [33]. Objective technology has, unfortunately, fluid meanings in the Technology Enactment Model. In some places, it seems to mean general characteristics of information technology and sometimes an implemented digital artifact as such. In the PDE model, there is an important difference between 1) digital technology with general characteristics giving affordances for digital design and 2) specific digital artifacts. "Technology" is never used to mean specific digital artifacts as can be the case in [10, 33]. An implemented digital artifact gives affordances and constraints for use. How these affordances and constraints are utilized, followed and appropriated by a user corresponds to "enacted technology" in the Technology Enactment Model. In the PDE model, institutional elements are not put in one "box". There are different institutional elements in the listed pre-conditions. "Egov policy" contains normative expectations from policymakers. "Regulations" cover all kinds of laws and statutes that pertain to the addressed workprac-

tices. These are two pivotal parts of institutions following [35]. “Workpractice circumstances” include other institutional elements that govern the kinds of workpractices addressed. There will be relational elements (such as stakeholder roles), linguistic elements (concepts and vocabulary), performative elements (established processes and procedures), and also normative elements (specific workpractice values). Such institutional elements may, through design processes, be inscribed in the digital artifacts and thus substantially affect its use and give practice impacts. The digital artifacts will be *mediators of the institutional pre-conditions* through its use.

## 6 Conclusion

This paper has contributed a conceptualization of the utilization of digital opportunities in e-government through the polarity of overexploitation vs. underexploitation. The conceptual development was based on a theoretical lens of affordances and constraints. This has been further theorized through the enhancement of a conceptual model (PDE) of Pre-conditions for design, Designed digital artifacts, and Effects that arise from their uses. Besides these obvious conceptual contributions that could influence further empirical and theoretical studies, the conducted inquiry demonstrates a way to research e-government with the following traits: a qualitative case study with a combination of inductive investigation aiming for discovery, evaluation of findings and use of a synthesized theoretical lens for conceptual development. This proposed case study approach involves also an alternation between three different foci in empirical inquiry, data analysis, and conceptualization: 1) different features of designed and used digital arrangements (i.e. connected digital artifacts), 2) a “backward” analysis revealing the rationale for design and other kinds of pre-conditions for design, and 3) a forward analysis clarifying both functional and dysfunctional effects from the use of digital arrangements. See Figure 1 for illustration; start with the center (1) and move backward to pre-conditions for design (2) and forward to effects from use (3).

Based on this inquiry the following advice can be given to practice: A challenge in this context is to achieve a balanced digital exploitation where you do not overexploit or underexploit the digital opportunities. The dictum should be: *Exploit digital opportunities in a balanced way to reach real improvements in workpractices*. An evaluation of how digital opportunities are utilized should not stop until an assessment of effects on workpractices and stakeholders is completed.

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