The Origins of Failure: Seeking the Causes of Design-Reality Gaps

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Abstract: Heeks' (2002) theory of design-reality gaps is an extant framework to explain failure of information systems in developing nations. This paper problematizes the nature of failure, with a particular focus on situations in which well-implemented systems, apparently corresponding to users' views of reality, still fail to meet the expectations of their key stakeholders. To extend existing theory on this phenomenon, I advance a diagnostic model to identify the root causes of design-reality gaps. The model is illustrated through a case study of the Ration Card Management System in Kerala, south India: by capturing the causal chains underlying design-reality gaps, the model sets to trace the origins of failure, and the processes through which it is ultimately determined. The model I propose is both explanatory and normative, as it elicits causes of failure and serves as a basis to combat them.

1. Introduction

The study of information technologies as means to improve people's life standards in developing nations has gained increasing relevance over time. Walsham's (2012) argument on the academic community's responsibility to "make a better world" with ICTs has drawn attention to the ICT for development (ICT4D) discourse, and has reinvigorated it by stating its ethical implications. The value of informatisation for the developing world is twofold: on the one hand, ICT diffusion has the potential of improving millions of lives, by positively

affecting marginalised economies and societies (UNDP, 2001; Bhatia et al., 2009; World Bank, 2012). On the other hand, the misuse of technology can lead to profoundly damaging effects, as well as to high opportunity costs which developing countries are not ready to take (Dagron, 2001; Heeks, 2005).

Given the state of the field, the theme of failure is particularly relevant to ICT4D. Heeks (2003) gives a preoccupying snapshot of this phenomenon: based on survey data, he estimates 35% of e-governance projects in developing nations as total failures, and partial failures as reaching 50% of the total. While survey data are contingent to time and space, these figures are corroborated by evidence from around the globe: still today, numerous narratives report on ICT4D projects being abandoned, left incomplete, or proving ineffective for their intended beneficiaries (e.g. Benjamin, 2001; Dada, 2006; Dodson et al., 2012; Lin et al., 2015). The mission of enabling developmental change through ICTs seems therefore incomplete without a study of this phenomenon, on which best practice models to prevent it can be grounded.

The information systems (IS) field has extensively studied failure, both in explanatory and in normative terms. Yet, only quite recently has the literature turned to models specific to developing nations: this is the case for the theory of design-reality gaps devised by Heeks (2002, 2003). As its name says, the theory ascribes IS failure to gaps between the way in which a project is designed, and the reality that the same project aims to fit. As a result of misfits, projects can be perceived as useless or suboptimal, and therefore be quickly abandoned, left unused, or not reach their stated objectives. This model is a leading one in ICT4D, and is upheld as the one core paradigm to study IS failure in developing countries (Walsham & Sahay, 2006; Avgerou, 2008; Andersson & Hatakka, 2013).

At the present day, some time after the theory's formulation, the state of the field calls for reflection on its assumptions. In particular, ICT uptake in developing nations has fostered changes in users' attitudes, and knowledge held by prospective beneficiaries has acquired unprecedented importance in ICT4D. Here I argue that, largely as a result of these trends, it is important to problematize the nature of failure that characterizes ICT4D projects today. To do so, I rely on Lyytinen's (1988) notion of *expectation failure*, referring to technologies that prove unable to fulfil the objectives that key stakeholders expect from them. Leading to

unintended outcomes, and resulting in frustration for its intended beneficiaries, expectation failure arises as one of the core problems in contemporary ICT4D.

In seeking explanations for IS failure, it should be noted that the theory of design-reality gaps focuses primarily on the *type* of gaps that may occur, rather than on the *root causes* underlying them. Misfits with the local reality can induce abandonment or non-usage, and prevent the system from reaching its goals: the existing framework outlines seven dimensions along which misfits may happen (those of information, technology, processes, objectives and values, staffing and skills, management systems and structures, and other factors). However behind these dimensions, there are root causes leading to disjunctures between designers and their environment, and these are not openly contemplated by the model as it stands. This generates the need for extension of existing theory, through a diagnostic tool that openly seeks to identify the origins of design-reality gaps.

The contribution made by this paper aims at achieving this explanatory purpose. Building on Heeks' approach, I advance a model that seeks to identify the root causes of design-gaps, and the ways they combine with each other into processes that ultimately lead to failure in ICT4D. To do so, I rely on a case – that of the Ration Card Management System (RCMS) in the state of Kerala, south India – in which a critical mass of users was indeed reached, but discrepancies between system design and its core purpose led the project to miss its objectives. Studying this case allows me to further problematize the nature of failure: technology is conceived as a carrier of policy (Cordella & Iannacci 2010), but diverse reasons may prevent inscription of intended policy principles into design.

Crucially, the paper does not aim to replace existing theory. Rather, it aims to revisit it by enhancing its explanatory power, and hence extending Heeks' model through a theoretical device that allows to trace the root causes of design-reality gaps. In spite of the very rapid digitization of world economies, IS failure still has strong negative effects on developing countries, which have limited capabilities to cover costs of failure and to face the burden of its perverse consequences. It is hence important to identify the causes of this phenomenon, in order to build a strong basis of ability to combat them.

For this purpose, the paper is organised as follows. In Section 2 I map the domain of failure in ICT4D, and review Heeks' explanation rooted on design-reality gaps. In Section 3 I

problematise the notion of failure, and state the rationale for building a model that investigates its root causes. In Section 4 I describe the case of RCMS in Kerala, and use it to discuss the nature of failure. In Section 5, I devise a new diagnostic model, which explains the root causes of design-reality gaps: the model is then put in practice to trace the causal chains underlying the failure of RCMS. Section 6 concludes, considering the new models' value in theoretical and normative terms.

2. ICT failure in developing nations: Design-reality gaps

Failure is a central theme in IS literature. In a sociotechnical conception of information systems, interpreted as social systems that use technology (Land & Hirschheim, 1983), failure does not simply coincide with technical malfunctioning, but with misfits of technology within the actor networks revolving around it (Polymenakou & Holmes, 1996). This conception gave rise to two main streams of literature: a descriptive/explanatory one, focusing on understanding reasons for failure and the mechanisms that determine it (Lucas, 1979; Lyytinen & Hirschheim, 1987; Lyytinen, 1988; Mitev, 1996; Bartis & Mitev, 2008), and a normative one, dealing with strategies to combat or prevent it (Keil, 1995; Cule et al., 2000). Both streams are predicated on recognition of failure's contextuality, but still attempt at identifying mechanisms recurring on a cross-case basis.

There are different forms of failure, of which the main ones are classified in the seminal taxonomy by Lyytinen and Hirschheim (1987). Firstly, failure can affect the development of technology. This is referred to as *correspondence failure* when system specifications are not met, and as *process failure* when systems, despite correspondence to design, are not properly developed into practice. Secondly, failure can occur in terms of systems' utilisation: this is referred to as *interaction failure*, and it occurs when the system is successfully developed and completed, but it is not utilised by its intended users.

On top of these, a third type is defined by Lyytinen (1988) as *expectation failure*. The problem in this case is not at the level of construction or usage, but at that of outcomes: we refer to expectation failure when the system does not meet the expectations of one or more groups of stakeholders. Unlike other concepts, this notion takes into account multiple stakeholders' views, and hence fits particularly well with a sociotechnical vision of IS (Yeo,

2002). But the key reason why this concept is relevant is that it evaluates systems according to their objectives, and can therefore state the difference between desired and actual achievements, through the eyes of the multiple stakeholders involved (Lyytinen, 1988, p. 54).

Why would we be particularly preoccupied with failure in developing nations? This theme has become relevant since the early days of ICT4D, and still features very frequently within the field. Throughout the literature, three reasons lead to considering failure in developing countries as particularly relevant.

The first reason is that developing nations, as they deal with failure, are faced with particularly high costs, which may be hard to cover. These are to be seen primarily as opportunity costs (Avgerou, 2008, p. 137), because the limited resources of developing nations may have a high impact if invested elsewhere. Yet, costs are also to be viewed in monetary terms, in particular as purchasing equipment, and keeping up with compatibility standards dictated by the West, can be particularly expensive for developing nations (Wade, 2002; Nauman et al., 2005). In addition, the cost of failure has also to be framed in non-financial terms: disappointment with ICT-led projects may lead to loss of trust in the actors behind them, which exacerbates the already existing problem of institutional frailty (Beeharry & Schneider, 1996; Heeks, 2005; Dada, 2006; Dodson et al., 2012).

A second reason is the frequency of failure, which – in spite of the progress achieved over the last decades – is still high in the developing world. Heeks' (2003) survey, while dealing specifically with the sub-domain of e-governance, does ring an alarm bell, as it reveals that of the many sampled projects, only 15% can be classified as fully successful. On the one hand, lack of more recent data on failure's incidence (in a historical phase in which uptake of ICTs is exponential) limits the extent of plausible inference on this, especially considering the rise in evidence of success (Walsham, 2012). On the other hand though, factors of preoccupation towards frequency remain: diffused institutional frailty, as well as hurdles in technology adaptation and diffusion, have great potential in augmenting failures' incidence, and still are recurrent in the developing world.

Finally, as noted above, failure can significantly affect development planning, and the capability of government and other actors to build better life standards for citizens. As noted above, in an epoch of digital pervasiveness like the present one, ICT is ambivalent: it can

contribute greatly to progress in development, but can also result in great cost if misused. Substantial IS projects, if failing in developing nations, can lead to miss opportunities to increase people's quality of life, or even worse may put existing standards at risk. Examples like that of anti-poverty schemes, which in many countries are being computerised, are paramount in illustrating relevance, as e-governance there affects people's capability to access basic-needs assistance (Bussell, 2012; Pritchard et al., 2013).

Cost, frequency and relevance are hence the main reasons for focusing on developing countries when studying IS failure. But has this been done already? To what extent can we avail existing theories to explain the roots and dynamics of this phenomenon?

It should be noted, in the first place, that most work on IS failure in developing countries is descriptive (Dada, 2006). This means that empirical evidence is indeed analysed, but generalisation to theory is not undertaken as a result. One reason for this is the contextuality of failure (Avgerou, 2001): suboptimal outcomes do not only stem from the malfunctioning of systems, but from clashes of technology with the social groups revolving around it. Taking stock of the contextual nature of this phenomenon, many stick to simple description, without moving to theorisation of what is observed.

And still, this is not always the case. The big exception, and the model that became most used across the years, stems exactly from Heeks' (2002, 2003) attempt to systematise knowledge on failure. His account is indeed capable to transcend anecdotes, and draw on cross-case regularities to advance possible explanations. What he puts forward is a theory of IS failure, devised to explain the phenomenon as it occurs specifically in developing countries.

The theory, known as the approach of design-reality gaps, views discrepancies between IT design and reality as a key source of failure. Among the many differences across cases, Heeks notes a common pattern underpinning failure, based on discrepancy between system design and the features of the reality that it encounters. According to Heeks' taxonomy, flawed assumptions may influence the domains summarised by the ITPOSMO acronym in Figure 1: information, technology, process, objectives and values, staffing and skills, management systems and structures, and other factors.

[Figure 1 here]

How do design-reality gaps occur in practice? Among many instances, Heeks (2003, p. 5) identifies three main threads at the root of discrepancies. *Hard-soft gaps* are found when a "hard" design meets a "soft" reality, that is when IT systems follow a techno-rational logic, which does not take into account "soft" factors such as people, politics and culture. *Public-private gaps* arise when systems designed for the private sector, embedding the market logic that pertains to it, are implanted into public governance with little or no adaptation. Finally, *country context gaps* play a major role here: systems designed in and for Western nations cannot be promptly replicated into developing countries, without a complex process of reconstruction which takes local specificities into account.

Through the years, the theory of design-reality gaps has been upheld as a model for the sector. Walsham and Sahay (2006) recognise it as one of the theories that, originated inside ICT4D, have become relevant to explanations of phenomena in IS at large, hence exemplifying the opportunity for cross-fertilization and mutual learning between the two fields. Beyond its explanatory power, the approach has normative potential, as it allows to identify where gaps are located and to devise specific strategies to fill them (Heeks, 2003, p. 9). And still, how complete is the explanation of failure that the design-reality gaps model provides?

3. A new model: Seeking the causes of gaps

IS literature, and Lyytinen and Hirschheim's taxonomy in particular, outline the presence of different types of failure, each of which is characterised by its own reasons and dynamics. Heeks' account distinguishes between *total* and *partial* failure: total failure refers to projects which are left incomplete or abandoned (Heeks, 2003, p. 2), and hence recalls the notion of development failure in Lyytinen and Hirschheim. Similarly, partial failure refers to projects that while complete, are still unable to reach their intended users, an idea that Lyytinen and Hirschheim refer to as interaction failure. It also refers to those which miss some of their main intended objectives, and in this it is akin to expectation failure.

The theory of design-reality gaps is grounded on discrepancies between worldviews that can cause failure both in total and in partial terms. If flawed assumptions on the local reality

cause a gap between designers' and users' view, this can easily emerge prior to implementation, and the project will hence run the risk of being abandoned. Instead, if the gap emerges when the project has already been implemented, intended users will have little incentive to utilise the new system. Both instances came across as common in the early days of ICT4D, when large telecentre projects, involving networks of Internet kiosks aimed at citizens that would barely ever use them, were depicted as the epitome of failure (Dagron, 2001; Heeks, 2005).

In the current historical phase, in which IS failure is still a reality in spite of increasing worldwide digitization, it is important to problematize the different natures that failure acquires. This is particularly true for situations in which a new information system is used properly, but the underlying project is still unable to deliver the expected benefits. Now, this is not a problem of development, and not even of suboptimal utilisation: the problem lies in the fact that the system on paper works well, but in practice it still does not deliver the outcomes that it should pursue. This does not generate effective solutions, but additional costs and frustration towards ICTs.

It should be noted that, when the design-reality gaps theory was conceived, pressure to explain sheer expectation failure (arising independently from development and interaction failure) was probably limited. But an overview of the recent evolution of ICT4D reveals that this phenomenon has a greater weight now, due to the concomitance of two macro-trends. The first one consists in the much greater uptake of ICTs in developing nations: exponentially rising adoption rates, with particular respect to the Internet and mobiles (World Bank, 2012), have fostered a trust effect that countered technophobia, and resulted in greater reliance on ICT (Avgerou, 2013). The second trend, more subtle, is a push towards localisation, intended as the proactive inscription of prospective beneficiaries' views, ideas and necessities in the making of ICT4D projects (Walsham et al., 2006; Puri & Sahay, 2007).

Arguably, both trends have determined a shift in the types of IS failure that prevail today. On the one hand, the desolation of the myriad of projects left incomplete (or unused, in spite of the huge costs sustained) is on a decreasing trend worldwide, though cases of development/interaction failure are still found in several instances. But it still remains that, on a world scale, many projects do not reach the intended outcomes, even if they look optimal

on paper. This calls for a systematic examination of the causes of design-reality gaps, aimed at tracing the roots of this phenomenon and its connections to different types of failure.

And it is here that a contribution to the existing model, observing the *types* of design-reality gaps that occur in practice, may be needed. The existing theory does have an explanatory nature, but focuses more on the proximal causes of gaps than on the processes underlying them. For example, a gap along the "information" dimension (as in Heeks, 2003, p. 5) may reflect a disjuncture between a system that creates formally structured data, and a users' reality in which informal exchanges and unstructured "gut feelings" are what is valued. What we do not know from the model is, what are the foundational reasons for this disjuncture? And in particular, why would designers be unable to provide a system that responds properly to users' needs?

To answer these questions, we need a model tailored on explaining the root causes of design-reality gaps. What we aim to grasp are the causal processes underlying them, framed in terms of the chains of events that lead to discrepancies between designers' and users' worldviews. To pursue this objective, a theoretical model should encompass two dimensions: a *static* one, classifying different causes of design-reality gaps according to their nature, and a *dynamic* one, looking at how different causes are interlinked with each other. Below I apply this idea to a case of IS failure, which allows me to formulate clearer theoretical propositions.

4. Explaining gaps: The Ration Card Management System (RCMS) in Kerala

The case study illustrated below pertains to computerization of the Public Distribution System (PDS), a food security programme run by the Indian central government and implemented by state-level administrations. The PDS is based on the distribution of primary necessity goods (mainly rice, wheat, sugar and kerosene) to below-poverty-line (BPL) households at highly subsidised prices, thereby aiming to significantly increase their nutrition and welfare. These goods, procured by the national Food Corporation of India, are redistributed through fair-price shops, known as "ration shops" as the amount of commodities per household is rationed on a monthly basis. For a steadily high share of households in India, the PDS is crucial to fulfilling basic nutritional needs (Drèze and Khera, 2015).

Fieldwork has been conducted in the southern Indian state of Kerala between November 2011 and September 2012, at a time when the PDS was undergoing a state-led process of computerization. I have conducted 126 in-depth interviews with actors participating in the PDS, and in its transformation through digital technologies. Three main social groups were placed at the core of analysis: the actors governing the PDS, the designers and implementers involved in its computerization, and the beneficiaries accessing the programme throughout the state. In addition, I have interacted with actors revolving around the system in different ways, such as politicians, volunteers at pro-poor organisations, and activists campaigning for people's right to food. Following the case study method (Yin, 2009), narrative data were then triangulated with documents on the system and with participant observation of the digital PDS, conducted in the spaces (government offices, telecentres, ration shops) where the system's procedures were computerized.

To access the PDS, each household needs a valid *ration card*, a document of entitlement that proves poverty status – according to which the amount of subsidy is determined. And indeed, obtaining a ration card is one of the hardest parts of the process: the card is stamped by the shop owner every time rations are collected, and needs therefore to be renewed when pages are finished. Furthermore, every household is assigned to a ration shop based on locality, meaning that if a household relocates, a new document is needed (the same holds true when a new family is formed, or when members are added or deleted). Given the frequency of ration card renewal, and the importance for the poor to obtain this document, it is very important that the system that processes ration card applications is effective and well-functioning.

And still, though Kerala scores high in most dimensions of social development (Parayil, 2000), effectiveness of the ration card system has been low for decades. My study of the Keralan anti-poverty system revealed consistently bad reports from citizens applying for ration cards. Prior to computerisation, the process required many months to be completed, and frustration for unmotivated rejections (or very long waiting times) was common. In August 2010, an estimated 600 thousand ration card applications were stuck in the pipeline, meaning an equal number of households being unable to access subsidised commodities. Ineffectiveness of the system was particularly detrimental, because it resulted in the denial of entitlements to the poor.

Prior to inscription in e-governance, the system was entirely paper-based. Applicants needed to present a form to the closest Taluk Supply Office, or TSO (a regional bureau of public administration), submit their application, and wait for a non-specified amount of time to get it processed by the Rationing Inspector's office. This is a centralised office, located at the Food and Civil Supplies Department in the capital (Trivandrum), and handling applications from the whole state: the lack of clear procedures for application processing, and the burgeoning amount of workload due to centralisation, would make turnover very slow. The challenge for IT designers was that of building an information system to make ration card delivery a smooth and timely process.

In September 2010, following software design and implementation by the National Informatics Centre (NIC) Kerala, a Ration Card Management System (RCMS) was officially launched. The system aimed at end-to-end computerisation of the ration card process: citizens would apply for ration cards online, generally through the kiosks known as Akshaya centres (government-led telecentres located across the whole state territory). Applications would then reach the Rationing Inspector, and the new cards would be printed by TSOs based on user data contained in a state-wide database.

My study revealed that RCMS, publicised as a great innovation by the time of its launch, has been implemented thoroughly across the state. All the Akshaya centres I have visited reported the ration card application as one of the services that users request most frequently. Taluk Supply Officers, interviewed on this, have provided consistent reports: when it comes to the issuing of ration cards, the digital process has almost entirely substituted the paper-based system. It seems therefore that not only the project is complete, but utilisation rates are high throughout the state.

But what is the situation in terms of achievement of results? While government surveys are not yet available, interviews to users across the state revealed widespread disappointment among them. Many reported that, while online application is indeed quicker (as compared to long queues at TSOs), long waiting times and uncertain outcomes are still a reality. In spite of computerisation, applications remain stuck in the pipeline, and while receipts (generated by the online system after application) carry a date for expected delivery of the document, disappointment is frequent. The state-citizen interface has indeed been computerised, but the back-end part of it still seems suboptimal.

Viewed from the inside, the structure of the e-governance system clarifies the reason for that. NIC designers focused on digitising the application phase, but not so much on tackling the problem at the level of the Rationing Inspector's office. The new information system, while dealing with the front-end aspect of application, has done very little to solve problems at the back end, where applications actually get stuck in a central office that needs to handle them all, with limited staff and capacity. There are indeed guidelines for computerising this too, but the extent to which they are followed is very limited. Visits at the Rationing Inspector's office, conducted at several points in 2011/2012, revealed persistently low levels of familiarity of the staff with the software provided for RCMS.

Launched as a revolutionary service, utilised by a critical mass of users, and yet unable to achieve its objectives, RCMS seems to provide an archetypal case of expectation failure. So much so that the system, at the moment of writing, is being dismantled in favour of a shift to biometric identification of PDS users. The system does not fail in development or usage, but its design does not lead to the expected outcomes: how is the problem explained?

5. Explaining design-reality gaps

Looking at the case of RCMS through Heeks' model, we can get a sense of the type of disjuncture that key stakeholders are faced with. The objective of RCMS is that of making the ration card process easier and quicker, but the system is not designed to do so: in fact, it prevents rationalization of the process, because the core bottleneck (at the Rationing Inspector's office) is not computerised. What we find is hence a gap between the *objectives* designed into the technology, and those held by key stakeholders towards the system. Based on the ITPOSMO acronym, this can be conceptualized as a gap along the first "o" dimension, representing "objectives and values".

But it is crucial to ask, what is the gap due to? It may be traced to different factors, and the ITPOSMO taxonomy does not lead to diagnose its origins. It allows to identify a clash between the objectives embodied in technology and the "real" reasons for building RCMS, but it does not support an analysis of the foundational roots of the problem. What I provide here is instead an additional diagnostic tool, aimed at investigating the processes culminating in the outcome of a design-reality gap.

5.1.Causes of design-reality gaps: A taxonomy

The factors at the root of design-reality gaps can be of different natures. It is useful to provide a taxonomy of the main types of reasons behind them, to understand the nature of the phenomenon in its multiple shapes. Different causes interact with each other, and it is hence important to conceive the origin of design-reality gaps in terms of dynamic processes rather than of factors operating apart from each other. The taxonomy proposed below has hence been constructed in terms of *classes* of causes, each of which refers to a particular set of processes.

In this respect, a set of classes of causes can be identified, and these are as follows:

1) *Informational*. Design-reality gaps may occur because designers are not fully informed on the problem to be solved, on its context, and/or on the tools available to them. For example in RCMS, designers may be unaware that the problem is at the Rationing Inspector's level, and this could have led them to consider computerisation of that part of the process as unnecessary.

2) *Technological*. At the same time, the problem may be on the supply side, which is the case when the technology needed for optimal design of the system is not available. For example, NIC Kerala may lack the ICT tools and skills needed to automatise processes at the Rationing Inspector's office. This can result in second-best choices, such as the front-end oriented design of RCMS.

3) *Financial*. Still on the supply side, the possibility of inscribing a certain rationale in the system can be subjected to financial constraints. For example, the Government of Kerala may be unable to afford back-end digitalisation of RCMS, at least as far as its crucial passages are concerned. As noted above, direct and indirect costs of computerisation may be a highly problematic factor for developing countries.

4) *Organisational*. It is even possible that design may not mirror the system's rationale because, all too simply, the rationale clashes with the organisational/political principles of those behind it. For example, in Kerala it may be politically problematic to digitise the

back-end, because this move is not physically visible to citizens demanding quicker issue of ration cards, as opposed to front-end digitisation which involves them directly and is hence a tangible sign of the government's commitment.

5) *Cultural*. Local culture can also be a factor affecting inscription of a certain intentionality into technology design. For example, in Kerala a back-end orientation may clash with local culture, which is very focused on activism and direct engagement of citizens with politics. As a result, culture may be a prominent factor in justifying the decision of prioritising computerisation of the front-end aspect of the process.

6) *Historical*. Path dependency induced by historical factors can also influence the nature of inscription. For example, Kerala's history as a left-wing state, in which the Communist Party of India-Marxist (CPI-M) and civic movements play a prominent role, may have been a factor generating higher predisposition to front-end digitalisation. Again, front-end architectures involve citizens directly, whereas e-administration in this case is not visible to users.

7) *Institutional*: finally, norms and routines inscribed in existing institutions may also play a role in the process. Institutional factors, in Kerala's Rationing Inspector's office, may include low predisposition to e-governance, and potential resistance of the staff to the adoption of new practices and computerisation. This could reasonably have influenced designers' will to inscribe a back-end orientation in the new system.

[Figure 2 here]

The proposed taxonomy of possible causes is summarised in the model above. Its nature is different from Heeks': the model subsumed in the ITPOSMO acronym classified flawed assumptions of designers on reality, and the different forms that such flawed assumptions could acquire. My model, acronimysed as ITFOCHI, aims instead at seeking the root causes of design-reality gaps, to understand how exactly they contribute to IS failure. As it is shown below, these causes interact with each other, and it is in this dynamic dimension that the model finds its fullest explanatory value.

5.2.Using the model: Tracing causal linkages

To trace the causal chains underpinning IS failure, I apply the model to the dynamics encountered in my study of RCMS. First I review the hypotheses formulated with respect to each class of causes, and assess the extent to which these correspond to the reality represented by the data collected. I then look at the ways in which different sets of causes interact with each other, forming the processes that result into a gap between the objectives inscribed in technology and those held by key stakeholders.

In terms of information, IT designers at NIC worked very closely with the Food and Civil Supplies Department, of which the Rationing Inspector's office is a part. The two counterparts, located close to each other in central Trivandrum, cooperated very closely to design and implementation of RCMS in its diverse components. This makes it hard to sustain the hypothesis that designers may be, in this case, unaware of the issues experienced in the ration card process, and of where exactly the main problem is located. The hypothesis that asymmetric information may be the problem is not supported by the empirical data available.

On the hypothesis that the gap could be due to technological and financial constraints, this could in principle by the case in Kerala, a state which does not fare high in terms of capital accumulation (Parayil, 2000). But even these hypotheses are problematic, as the software required to automatise administration of ration card processes is a relatively simple one, already adopted in less technologically advanced states (Bhatia et al., 2009). On top of that, automatisation would have been within the state's budget, and as confirmed in interviews with staff at NIC, it would definitely not cost more than other e-governance tools that the state adopted at the same time. These data support the view that in this case, supply side factors have had a relatively limited influence.

However, the organisational and political principles of the Government who commissioned the system may have played a more significant part in the process. Indian anti-poverty policy is deeply imbued with political value, since both social policies and electoral strategies are predicated on long-term visions for the poor (Corbridge & Srivastava, 2013). In the case of RCMS, targets of effectiveness are to be balanced with local politics: as such, behind e-governance in Kerala there is the government coalition in power, currently the United Democratic Front (UDF) led by the Indian National Congress. If an anti-poverty programme

is computerised, it is crucial that this is done in a politically appealing way, and not by chance RCMS has been launched in September 2010, shortly prior to the Kerala state elections held in 2011.

In this context, e-governance had to be more than a tool for transparency, and aimed at transforming the PDS as a key interface between citizens and the government. With the elections approaching, and the crucial policy role of RCMS, political considerations became determinant in building a system which prioritised automatisation of the front-end part of the process. As a result, RCMS has acquired its current shape, as a system in which the long queues (and frequent frustration) at TSOs are substituted with the user-friendly space of Akshaya telecentres, built in order to maximise citizen's trust (Madon, 2005; Gopakumar, 2007). Automatising procedures at the Rationing Inspector's office, which does not involve the citizens directly, would have been a far less visible policy move.

Still, this requires further contextualisation at the cultural and historical level. Optimisation of the PDS in Kerala is indeed a major object of electoral contention, which is not equally true in all Indian states, varying deeply in terms of how social policy is handled. In Bihar for example, different dynamics lead the PDS to be far less effective than elsewhere, a problem perpetuated by the incentives to diversion of PDS goods to the market (Mooij, 1999). Similarly, in states where civic engagement is less entrenched in political history, an interactive mode of computerisation would probably have had lower appeal on users. But on this, Kerala's history makes a remarkable difference: sustained by the politics of class struggle (Heller, 1995) that characterised the state since its early days, citizens became very used to civic engagement, which characterises many aspects of Kerala's political life. This has played a major role in determining prioritisation of the front-end for public IT architectures.

Finally, the hypothesis of institutional causes should be taken into account. When visiting the Rationing Inspector's office, I have indeed found evidence of institutionalised resistance to innovation. Staff members interviewed about RCMS did not seem enthusiastic about digitalisation, especially because its purpose and implications seemed to be generally unclear and not properly specified. It needs to be noted that these employees had not been trained on IT at the time of my visit, and by then e-governance in Kerala was in a moment of transition, influenced by the upcoming elections and by the quick pace of technological change.

Institutional factors therefore may matter, but in this specific case, they seem to reflect the environment more than making a difference *per se*.

According to the data systematized here, converging organisational, cultural, and historical processes have concurred to determine the gap at the origin of IS failure. Kerala's history of civic engagement is reflected in specific political patterns, leading to prioritise front-end technologies that directly involve citizens as users. These technologies are also more directly visible, as compared to automatisation of back-end nodes: visibility is crucial in pre-election times, especially when a popular programme like the PDS is involved. We can hence sustain that deep-seated processes, along with conjunctural factors linked to electoral competition, have led to the outcome of IS failure.

[Figure 3 here]

As illustrated above, a tangle of history, culture and politics is at the core of the causal chain that led to NIC Kerala's focus on the front-end of RCMS. This clashed with a reality in which the need of users was that of speeding up the issue of ration cards, which would have required intervention on the core bottleneck at the back-end level. By making the information system non-conducive to greater speed, this gap has played a role in expectation failure, as many applications still remain stuck in the part of the process that is not automatised.

It is important to note, as a coda to the model proposed here, that the vision of design-reality gaps carries deep signs of the socio-technical view of information systems that has inspired it. The technology is in fact considered beyond its materiality, and examined as the embodiment of a rationale – or more precisely, a "carrier of policy" as in Cordella and Iannacci (2010). If policy is not properly inscribed in technology design, this is due to a set of interconnected reasons, which the ITFOCHI taxonomy allows to identify and study as interlinked into causal chains. While different situations will lead to infinite combinations of causal factors, the categories proposed here constitute a taxonomic scheme in which processes are seen as connected, rather than avulsed from each other.

5.3. Scope and limitations of the model

The diagnostic tool devised here acts as a completion to the theory of design-reality gaps, focusing on the root causes that existing theory does not openly contemplate. Its explanatory value lies in a holistic interpretation of the origin of gaps, as it builds on proximal causes to investigate the deep-seated reasons behind them. The model proposes the ITFOCHI taxonomy to seek the origins of gaps, and uses it to trace the connections of different processes into the causal chains underpinning failure. By doing so, it provides a historical vision of the formation of design-reality gaps, which contributes to the understanding of this phenomenon as dynamic and processual rather than static.

It should be noted that the model proposes a way to structure explanatory reasoning, and may hence be *per se* insufficient to provide a full picture of the micro-dynamics behind specific cases of failure. As all models, it provides a stylized representation of the reality – it hence does not caution against the risk of working with asymmetric information, or of being misused due to biases in the data or in their interpretation. To work with the ITFOCHI taxonomy, the researcher needs to formulate hypotheses related to each class of causal processes, and these need to be then verified based on the data. While ITFOCHI provides a structured way to do so, it does not caution against the risk of working with suboptimal data, or providing simplified representations of causal chains of a complex nature.

In the scope in which it is useful to explain the origins of gaps, the model also finds a normative value, as structured knowledge on the origins of problems can increase our chances to prevent them. For example, it may be possible to act on conjunctural factors, which contribute to causing IS failure at a particular point in time. In the case of RCMS recounted here, the pre-elections critical time may have increased the need for governing forces to devise a politically appealing system: the history of the state, with its cultural and political specificities, increases the appeal of ICT solutions oriented to the front- rather than to the back-end. While it is hard to act on deep-rooted historical processes, a holistic understanding of the issue helps devising possible solutions, which in this case could include sensitization of the public on the importance of digitizing the back-end.

6. Conclusion

In this paper I have advanced a model to explain the causes of design-reality gaps, by providing a taxonomy of different causes and studying how these interact with each other. The example of RCMS in Kerala, which aims at speeding up ration card processes but is not designed to do so, is an archetypal case of expectation failure, a phenomenon that preoccupies the ICT4D world today. The case has been used to illustrate the model advanced here, aimed at tracing the causal chains behind the gaps that are found at the origin of failure. By doing so, it has explained the apparent paradox of a system that, while implemented properly and adopted by a critical mass of users, still fails to meet the objectives of its key stakeholders.

As it has been constructed, the model provides a basis to systematically analyze the phenomena at the root of failure. This is important in a single-case perspective, as deconstructing a system's failure into its underlying mechanisms helps obtaining a full picture of the studied phenomenon. Furthermore, conducting the ITFOCHI analysis on multiple cases may help identifying recurrent mechanisms, and hence generate cross-case theory on processes that result in failure across developing countries. In this respect, a desirable use of the model is that of replicating it on multiple examples, to identify recurrent patterns and devise strategies to prevent them.

Furthermore, understanding the root causes of failure provides a strong normative basis to prevent it. In the case of RCMS, the problem lied in a mismatch between the intention of speeding up the ration card process, and a design that over-prioritised the front end of technology. A sound plan of intervention should have addressed this asymmetry, by enhancing digital procedures at the Rationing Inspector's office – and enacting a parallel political strategy to defend this move in sight of elections. Though the project is now being replaced with biometric identification of ration card holders, imbalance between front and back end may remain, and lessons learned through RCMS should be kept in mind as the project moves to the next stages.

Avgerou (2013) signals the paucity of explanatory theories in information systems today, and the backlash of this on our capability to draw normative suggestions from causal inference. Heeks' model is an exception to this, since its explanatory power is recognised at a world scale in ICT4D. I hope that the model proposed here may provide a useful completion to Heeks', and a diagnostic tool on which to build effective action plans.

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