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# Competing Affordance Potencies Shaping Data Collection: Case of Humanitarian Organizations

Completed Research Paper

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## Abstract

*Individual adoption of technology in humanitarian settings is linked with expectancies of performance and effort, and users tend to easily default to “whatever works”. A deeper understanding of the process of field users’ adoption of a new technology is of utmost importance for humanitarian organizations. We used Affordance Potency framework for comparing competing affordances of a mobile based solution with existing paper-based processes, against 4 identified affordances. The mobile solution was deployed in seven inpatient wards of two humanitarian field hospitals during a period of four months. This analysis demonstrated how technology features are as important as it is to be flexible to respond to contextualised work practices. The affordance potency lens helped understand how competing systems can shape the data collection process. A key contribution of this study is the use of affordances from a “competing” lens perspective within the unique context of a humanitarian organization.*

**Keywords:** affordances, affordance potency, health information system, humanitarian organizations, mobile data collection

## Introduction

Humanitarian interventions are rapid and uncertain. In response to a sudden need, international organizations deploy multiple response mechanisms where specialised human resources, logistics, and information comes together to act in remote and usually unknown settings under emergency conditions. Whether caused by manmade or natural disasters, humanitarian crises generate immense acute and long-term health impacts on hundreds of millions of people, who have restricted access to the basic health care services. For humanitarian organisations, having access to data on the health status and needs of the population is at the basis of decision-making and a central component of humanitarian response.

In global responses to big humanitarian crises, the capacity to collect and share information across organizations is of vital importance, as demonstrated during the 2010 Haiti crisis response, where SMS and social media were used for sharing information in ‘real-time’. The high degree of information fragmentation in the Haiti response highlighted the importance of the inter-agency coordination (Altay and Labonte 2014; Chan et al. 2019). Maxwell and Watkins (2003) analysed the interdependent components of a humanitarian information system by studying long-term emergency cases in the Horn of Africa,

identifying the cost of vital gaps in baseline information in the Ethiopia food security crisis (1998-2000), the program management in the Kenyan rainy seasons crisis (1999-2022), and the early warning system crisis to support the Burundi political violence (1996-2001).

The need of information for coordinating emergency response is crucial, but this is dependent on the intra-organizational capacity of actors to generate data from its internal systems and processes. The primary focus of this research is on information systems (IS) in intra-organizational settings of humanitarian entities which remains a neglected area in IS research, and reflects unique characteristics as contrast with inter-organizational IS. These include: i) extreme reliance on paper-based data tools partially caused by the speed and changing dynamics of daily work; ii) uneven and low IT literacy levels and high staff turnover, raising the need for constant retraining, which is hard to come by; and, iii) limited digital infrastructure and prior experience with digital systems.

In such unique conditions, digital interventions may be seen as a burden rather than a boon, as the field teams need to constantly juggle resources and time with providing urgently required medical care. As a result, many modern digital solutions are rejected in favour of low-tech solutions, or even no tech solutions (Harvard Humanitarian 2011). This raises the need to pay close attention to micro-level processes of how users accept or reject new digital solutions, and what value they are seen to add or not to their everyday work processes in a humanitarian setting. As this field of research is relatively nascent (Kabra et al. 2017), there is a lack of systematic evidence of such implementation dynamics, which motivates us to analyse the routine Health Management Information Systems (HMIS) and learn from daily practices of data collection in the context of digital mediation inside one humanitarian organisation.

The research setting for this study is a field mission of Médecins sans Frontières Spain (MSF Spain), organisation delivering emergency aid to people affected by armed conflict, epidemics, natural disasters, and exclusion from healthcare. In 2014, MSF Spain developed their HMIS with the aim of enhancing the use of information to support operations throughout the organization. A significant amount of effort for data collection is invested in gathering and compiling data to enter in the HMIS, which is used for project management. There is a widely held perception, however, that the collection and analysis of data diverts resources away from more crucial operations of providing care services.

To ease the burden of data management, digitization of these processes is often presented as a possible solution, without taking resources away from care provision. Our project was carried out in an MSF mission ongoing in South Sudan, which provides medical services to an internally displaced population camp. Taking advantage of the introduction of a new mobile-based data collection system in the field hospital, we studied the day-to-day work processes of humanitarian workers and their interactions with both -old and new- data collection systems and related work processes.

By contrasting the perception of users to both paper and digital-based artefacts, this research aims at building understanding of the respective micro-level processes shaping the use of digital systems by humanitarian health staff, the competition which emerges across these two systems, and how the use of technology is shaped by the particular characteristics of the humanitarian setting. We adopt a theoretical perspective based on the Affordance Actualization Theory (AAT) (Strong et al. 2014) and Affordance Potency (Anderson and Robey 2017).

Affordances, which concern “the potential for behaviours... arising from the relation between an artefact and a goal-oriented actor” (Strong et al. 2014, p. 69), allows for a better understanding of the relationship between the technical and the social. AAT focuses on understanding how users can better actualize the affordance potential and make expected use of the technology. Drawing on AAT, we use the concept of affordance potency (Anderson and Robey 2017), defined as the strength of such relationship, as a framework for comparing how users perceive the competing paper and digital systems, and how this shapes their acceptance (or not) of the digital.

Our paper contributes by empirically building the concept of “competing affordances” which is relevant to understanding how the new digital interventions compete with the capabilities of existing systems, paper or otherwise. We conceptualize the system components, related practices and processes using an “ensemble” perspective (Orlikowski and Iacono 2001) to understand their implications on system use. This leads to the following research question:

*How do competing affordances of paper and digital technologies shape practices of data collection in humanitarian settings?*

To answer our question, we first identified the situated affordances (Anderson and Robey, 2017) by analysing the work of the health staff focussing on how systems are used, without limiting understanding only to the features of the system but to the actual information practices. The potency of the resulting affordances is then analysed from a “competing affordance” framework including the three factors influencing the actualization: user abilities, technical features, and context (Strong et al. 2014).

This research is an action case project (Vidgen and Braa 1997) which took place between September 2019 to March 2020 covering the deployment and assessment of the digital solution, with a total of 9 weeks in the field site over 2 separate trips. Data collection methods were carried out during both phases and included a mix of participant observation, focus group discussion, in-depth interviews, and studying the data from the HMIS system. Data analysis consisted of a thematic content analysis of the interviews transcripts and research notes complemented with a quantitative data analysis of the HMIS.

Next, we first discuss literature relevant to our case and analysis, followed by a description of the research site and data collection and analysis methods. Following this, we present the analysis and findings, subsequently discussed to frame our contribution, followed by conclusions.

## **Literature Review**

This section is divided into three sub-sections. We first position our work within the research field of humanitarian IS use and adoption. We then present key concepts of AAT and affordance potency, which provide the core for our analysis. Finally, we present the overall analytical framework that guides this research.

### ***Humanitarian Health Information Systems***

The importance of reliable information is heightened as the number of people affected by humanitarian crises has almost doubled over the past decade and is expected to keep raising (MSF 2014). Health management information systems play a crucial role in responding to emerging informational needs and strengthening systems of accountability in decision-making (Lewis and Madon 2004). Non-governmental organizations (NGOs) are increasingly using their routine data systems for their decision making (Braa and Sahay 2017), but their potential value has remained largely underutilized.

Three pillars are relevant for humanitarian organizations to monitor the progress and results of their health interventions: Surveillance, to track changes in disease incidence and mortality over time to guide disease control practices; monitoring, to check the progress of the interventions and; evaluation, to assess completed programs or phases and their impacts in reducing disease incidence and mortality (MEASURE-Evaluation 2020). Information for these three pillars is mainly obtained from i) routine health information systems (called HMIS), which facilitate ongoing facility and community level collection of health information and regular reporting throughout the organization; ii) health facility surveys, to examine whether or not patients are receiving the service they need, assess quality, infrastructure, supplies and human resources to provide adequate services and; iii) household surveys, usually covering multiple health interventions, whether age or disease-specific, or helping to populate demographics estimates (Sawadogo-Lewis et al. 2021). This study focuses on the routine HMIS, which provides the foundation for managing short and long term humanitarian interventions (Mesmar et al. 2016).

The nature and context of humanitarian business are different from other more structured and routine market-driven contexts (Tusiime and Byrne 2011). Humanitarian organizations face the unpredictability of situations, reduced human resources capacity, and general uncertainty about what happens next (Tafere 2014). Deploying new information systems becomes particularly challenging because of this and other contextual particularities related to limited existing experiences with digital systems, weak digital infrastructure, and extreme manpower turnover (Mesmar et al. 2016). These translate into challenges that generally go beyond technology and stem from organizational issues, culture, and environment (Maiers et al. 2005).

The highly decentralised model of humanitarian interventions also influences the processes of individual adoption of technology, which is often not linked with personal motivations or trust in the system, but rather to the performance and effort expectancies of individuals (Kabra et al. 2017). Users need to perceive that the selected solutions will easily add value to their hectic day-to-day activity and not merely add work, otherwise, they will default to “whatever works”, which includes the rejection of the digital. In a field hospital, for example, users need to find a fine balance between information system needs –such as data collection or routine reporting, while engaging with their activities of providing medical care and managing the hospital wards. Finding the right balance is a non-trivial challenge, as the workers typically come from a health care background, IT competencies are limited and there is a rapid turnover of staff raising the need for continuous (re)training (Tafere 2014). Often field users might end up working according to their wishes, by choosing a separate software, or not using a software at all (Kabra and Anbanandam 2016).

Aspects like user involvement, human-computer interaction, and data workflows, haven't generally received much attention in this domain (Kumar et al. 2018). Deeper understanding of the processes that lead users to adopt or not a new solution is of utmost importance, particularly in the humanitarian field as technology penetration is relatively at a nascent stage (Kabra et al. 2017). Research focus must shift from evaluation of effects to study of processes around user adoption of technology (Tusiime and Byrne 2011), seeking to build context-specific theories (Burton-Jones and Volkoff 2017). Drawing upon learnings from IS research for such theoretical development, is crucial in this effort. This will contribute both to the domain of humanitarian health IS, and mainstream IS research which is increasingly focusing on digital interventions in humanitarian settings.

### ***Affordance Actualization Theory and Affordance Potency***

James J. Gibson (1979) articulated the concept of affordance in the domain of ecological psychology, to study the perception of animals of their surroundings. In its original definition, affordance is what is offered, provided, or furnished to someone or something by an object. It expresses that goal-directed actors perceive an object in terms of how it can be used, and not as a set of characteristics independent from them. Affordances are perceived directly, not requiring a cognitive analysis of the features or characteristics of the object, emphasizing the relational and emergent characteristics of the systems (Chemero and Turvey 2007).

This perspective was taken to the technology domain, emphasising the relationship between the users and the technology and not only of the technology itself and extended to the information systems research (Stoffregen 2003). Strong et al.(2014) developed a mid-range theory – AAT – to help study the process that makes the user actualize the potential of the affordance understood as “the potential for behaviours associated with achieving an immediate concrete outcome and arising from the relation between an artefact and a goal-oriented actor” (Strong et al. 2014, p. 69). Affordance is seen as a potential that can be actualized, actualization comprises “the actions taken by actors as they take advantage of one or more affordances through their use of the technology to achieve immediate concrete outcomes in support of organization goals” (Strong et al. 2014, p. 70).

This has raised the challenge for information systems researchers to understand the conditions that influence the actualization of affordances in situated contexts (Chaterjee et al. 2020; Hausvik and Thapa 2016). At an individual level, AAT defines three factors: i) users' abilities, ii) the features of the technology, and iii) the work environment (Strong et al. 2014). These factors that lead individuals to actualize affordances contextualised in our work are:

- i) System Features:** Humanitarian information systems demand support for intuitiveness since high turnover causes a constant loss of organizational knowledge and there always exists competition of learning with the conduct of everyday urgent work. Support for the application of intuition becomes crucial in such a setting.
- ii) User's abilities:** Data and digital literacy levels often vary, due to different prior exposure to technology which varies with the age or background of the health worker. Staff without the necessary competencies tend to consider the collection and reporting of data as an administrative function that competes with the provision of medical care.

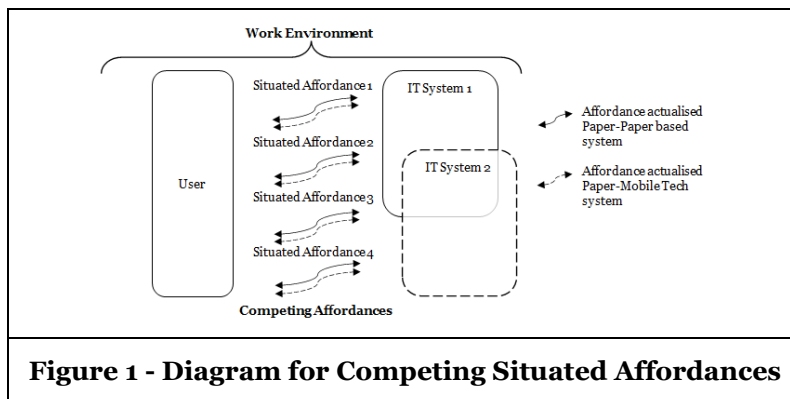
- iii) **Context:** In the physical context, some hospitals might have a proper desk and space for data collection, while others may not. Human resources (time and capacity) are frequently inadequate, contributing to a limited organizational data culture, which emphasizes care work over data related-work. The work atmosphere is intense and rapid, with health workers being often interrupted by different activities which need immediate attention, compromising time spent on data-related activities.

The model of affordance potency extends the idea of affordance actualization to understanding “the strength of the relationship between abilities of the individual and the features of the system at the time of actualization” (Anderson and Robey 2017, p. 103). Focusing on *the time of actualization* brings in the concept of situated affordances, which might or not correspond to the planned or designed uses of technology (Anderson and Robey 2017). Such a focus is of key importance in humanitarian settings where users are remote, making the provision of technical support challenging. The situated affordances empirical approach puts the users and their practices at the centre of the analysis situated in their everyday work context. These information practices provide the unit of analysis of the study.

The concept of the potency of situated affordances is relevant to study humanitarian technology adoption, as it provides a toolkit to i) position technology use in context and ii) assess the actual usability when combining the user, the solution, and the environment.

### Proposed Analytical Framework

In humanitarian settings, everything starts on paper, which does not disappear even when mobile technology is deployed. We thus adopt an ensemble perspective comprising the “ensemble of equipment, techniques, applications, and people that define a social context, including (...) the social relations and processes that make up the terrain in which people use it (Orlikowski and Iacono 2001, p. 122)”. This perspective helps study the multiple interconnected components of both paper and the newly introduced technology platform, the work practices around both, and how users interact with them within a situated context.



We work with the hypothesis that a strong potency is more likely to be actualized, as humanitarian users will adopt the path of least resistance. This implies for mobile technology to be preferred by users, it needs to have equal or more potency over its paper competitor. Observing both systems in conjunction allows us to study and analyse the “competing affordances” responding to the same goal-oriented action. To do so, we aim at understanding the perception of the users when they compare their experiences. The analytical framework is presented in Figure 1 above.

### Research Methods

This research project is one of action case (Vidgen and Braa 1997) aimed at learning from the deployment of a mobile-based application for data management processes. Action case represents an IS research framework for planning, controlling, and evaluating projects with high contextual immersion and situated research questions. Such a framework is particularly adequate for research in humanitarian settings that combines intervention and interpretation. Action case builds upon the assumption that organizations might limit what research can or cannot do, while at the same time benefitting from the potential to initiate change

from the research activity. This approach balances the contextual challenges of a full-scale research project by proposing a smaller scale intervention with deep contextual understanding, and the ability to learn from this smaller intervention when thinking about scale.

We find in recent literature small scale interventions with a deep contextual understanding using action case methodology such as a digital intervention for enhanced emotion analytics on user-generated content and behaviour in a large global automotive manufacturer (Sykora et al. 2022). Also, the development of multi-stakeholder partnerships to maximize the potential of collaboration for the refugee response. This intervention looked at a stakeholder partnership established to provide energy and host communities in refugee camps in northern Ethiopia (Moreno-Serna et al. 2021).

Our theoretical approach aligns with interventions where IS theories frameworks are used to study the changes that technical interventions can generate in an organisation, like the study of the implementation of a security awareness programme (Tsohou et al. 2013); to make deep theoretical analysis of the process of technology use (Hausvik and Thapa 2016), and technology implementation (Sigala et al. 2020); or to study the impact of a new technology on the decision-making processes of the organisation (Tona et al. 2016).

The study involved two main phases of deployment and assessment which took place between September 2019 to March 2020, with a total of 9 weeks in the field site over 2 separate trips.

### ***Research Site and technical intervention***

MSF is an international, independent, medical humanitarian organization delivering emergency aid to people affected by armed conflict, epidemics, natural disasters, and exclusion from healthcare. Our research was carried out under the operational directorate of MSF Spain, focused on providing care to victims of emergencies and operating in more than 30 countries in 2022. MSF uses the District Health Information System 2 (DHIS2) as their HMIS. DHIS2 is an open-source web-based health management information system developed and maintained by the University of Oslo (UiO), used extensively around the world by ministries of health, NGO's and international agencies. In MSF, the role of the HMIS is to collect data routinely from the projects to facilitate access to information for the coordination teams at different levels, from the field project to headquarters in Europe, and support the design and monitoring of their interventions.

The South Sudan country mission was selected as the main setting of this overall research project by the organization's medical department in collaboration with the first author. Selection criteria included context stability, type and number of projects and health facilities, the services provided and their volume of activity, and the status of the HMIS in the mission. HMIS has been operational in the South Sudan mission since 2015 and is used for data management in its current projects. This research focused on one of the field projects which provides medical services to an internally displaced population (IDP) camp established due to violent clashes back in 2015 and is situated in the second biggest town in the country before the conflict started in 2013. Today, nearly 16,000 people live in the town, and around 32,000 IDPs live in the nearby Protection of Civilians site (PoC). The project manages the Town Hospital and the PoC Hospital and is guarded by forces from the United Nations mission in the country. Both hospitals were included in the pilot.

**The deployment** of the new mobile data collection system was conducted from October 2019 to January 2020 in seven inpatient services from the two hospitals, including Adults, Paediatrics, Inpatient Nutrition and Neonatology wards in PoC Hospital; and Paediatrics, Inpatient Nutrition and Neonatology wards in the Town Hospital.

**The existing data collection system** in the hospitals comprised of the following steps: i) admission of patients to the ward, when their details are added to the register book and the patient file is completed; ii) weekly aggregation (usually on Monday mornings for previous weeks) from the register book into tally sheets, where patient data is tallied by age and sex, diagnosis, type of exit, cause of death and diagnostic tests performed. The nurse supervisor is responsible for this process with support from the data collector when available; iii) validation of data compiled by the nurse activity manager or the project medical referent, and at the end of the aggregation day the tally sheets are taken to the project base office to be introduced into the computerized HMIS system.

**The proposed solution** for a new mobile tablet was designed as the above process was perceived by the staff as being repetitive, time-consuming, and prone to human error. The solution consisted of introducing the DHIS2 Android app for data collection and adding a custom solution to automatically integrate the aggregated data into the HMIS system. This solution did not replace the first manual step involving the register book, which is extremely local and difficult to standardize, and was planned to be covered later. The expected outcomes of the intervention were: i) replacing weekly manual calculations with an automated aggregation process, and ii) replacing manual data entry with an automatic sync process to send the aggregated data into the HMIS.

### **Role of researchers**

The first author is a Ph.D. student and former member of MSF Spain, who was part of the team working on the design and global deployment of their routine HMIS. The second author is currently an active member of MSF Spain and plays the role of eHealth Epidemiology Advisor. The third author supervises the studies of the first author, contributes to the analysis and theoretical development, and oversees the Research Agreement between MSF Spain and the University of Oslo. The first and second authors were responsible for the technical intervention and field data collection.

### **Data collection**

Data collection was structured in two phases covering deployment and assessment of the digital solution. The deployment consisted of a one-month field visit (September 2019) where the first and second authors conducted two weeks of preliminary work before the deployment started. Key activities included technical deployment and in-service hands-on training for the users; project launch and two weeks of on-site follow-up. After the visit, the project was monitored and supported remotely over four months while users were working with the system (September 2019 to January 2020). Additionally, during this time, both authors participated in online meetings with the medical and project staff and followed up the practices around data collection, validation, and transmission in both the hospitals and the project base office. For the assessment phase, the first author visited the project in March 2020 and conducted an analysis of data quality in terms of completeness and accuracy, to understand to what extent did the intervention meet its expected aims of improving data quality.

The users involved in the study in both phases were the HMIS users in the project taking part in any steps of the data collection process, its aggregation, and subsequent entry into the system. Data collection methods were carried out during both deployment and assessment phases and included a mix of (a) participant observation; (b) focus group discussion; (c) in-depth interviews; and (d) data quality analysis of HMIS data. The data collection methods and participants involved are presented in Table 1.

Phase	Data Collection	Participants Involved
Deployment	Participant observation	All Medical staff
Deployment	Focus Group Discussion	Project Medical Referent (1), Nurse Activity Manager (2), Pharmacist (1), Medical Doctor (2), Nurse Supervisor (2), Data encoder (1), Laboratory responsible (1)
Deployment	Interviews	Nurse Activity Manager (2), Nurse Supervisor (2)
Assessment	Interviews	Project Medical Referent (1), Medical Doctor (1), Nurse Activity Manager (1), Nurse Supervisor (3)
Assessment	Data Quality Analysis	<i>No external participants involved</i>

**Table 1 - Data Collection sources**

A pre-deployment **focus group discussion** was carried out to validate the findings from the previous visit and identify new challenges as well as understand the suitability of the solution from a comparative perspective based on the experience and interpretations of the users involved. With a duration of one hour, one facilitator and one note-taker participated in the focus group discussion. The session was audio-recorded with the permission of the participants. The data collection team held a debriefing meeting after



the session to immediately document their observations and make note of the key points raised by the participants.

**Semi-structured interviews** were carried out with all field-level users involved to explore in more depth the experience and perception when interacting with both the existing and new system. The interviews were recorded with the permission of the participants. The average duration is 28'57" with a minimum duration of 19'56" and a maximum of 41'36". Interviews were made in English except for one which was in Spanish. Audio recordings were transcribed and translated to English when needed, as is the common language of the three authors involved. **Participant observation** of the users' daily activities in their different hospitalization wards was carried out throughout the two visits. Also study of the artefacts in use, books, forms, and registers. Participant observation notes were taken by both authors in written and/or recorded format. A total of nine single-spaced pages of notes were compiled and complemented with five recordings.

### **Data Analysis**

Data analysis took place in an interpretive mode of user perceptions around how the digital intervention had changed work practices and user perception around the data collection process. We tried to holistically make sense of the data collected combined with the empirical experiences and observations of the challenges experienced during the preparation, deployment, and assessment of the project. Our main analysis and findings are based on the interpretive process. The quantitative data quality analysis helped contrast findings as compared to user perceptions.

The onsite presence of two of the researchers during the deployment of the pilot solution resulted in many conversations between them, referring to respective notes, all of which deepened the understanding of the phenomenon under study. The third author enriched the structured analysis and discussions with an outsider view, linking the empirical understanding of the phenomenon with theoretical concepts around affordances.

A thematic content analysis (Miles and Huberman 1994) of the interviews transcriptions was used to identify emergent themes from the interviews and focus group discussion. Each author analysed the complete data set independently in two rounds. Results were shared among authors and combined with the notes from the day-to-day observations. The first round focused on the identification of our key themes for analysis, and the work practices. As our understanding developed, we grouped technology use with practices related to the paper-based data collection system. The uses of the system grew and took shape into the concept of situated affordances, which broadened the scope to more informal practices. The most salient work practices were identified through discussions between the authors. The second data analysis round aimed to relate those themes to our theoretical concepts around affordances. Identified practices were grouped as affordances and guided by the proposed potency framework, we analysed the response of both the new and old systems. This involved moving iteratively from data to theory and discussions to interpret the user's perception of the data collection processes from which the potency of each of the affordances was inferred.

An example to illustrate this process of analysis is the practices around the management of the ward. In the interviews, users were asked to describe the uses they made of the paper register. In the first round of analysis, we individually started observing that many of the responses described actions not related to the health conditions of patients in the ward (outcome of patients, causes of death, salient diagnosis). They referred to actions linked with the logistics of the ward. Some of those activities were: the counts of patients to plan for meals for the coming day, new admissions to keep track of bed nets distribution, or estimate the usage of clean bedsheets. Those activities were not considered by the data collection system and did not match any features of the system, neither the old nor the new one. They were however identified systematically by the authors and were grouped as daily logistics practices. In the second round, this theme was analysed and conceptualised as the affordance of *Managing ward logistics*.

Finally, the four resulting affordances were analysed individually and assessed comparatively for each system using the Affordance Potency framework. Affordance Potency was defined by the perception of the users about system features and the user abilities. An affordance with **strong potency** was that in which system features were seen by users as being adequate for the context, produced expected outcomes, and users felt comfortable in using the technology without functional barriers. Affordances had **weak potency**

when the system features were seen as a barrier and users did not have either the adequate conditions or capabilities to use the technology as expected.

The following table summarises the process for reaching conclusions about strong and weak potencies. Overall Potency of each affordance was decided as the result of combining the three factors in play.

Affordance Potency	Strong	Weak
System Features	System features produce expected outcome.	System features do not respond to users expected outcome.
User Abilities	Users feel comfortable using the technology with their skills and knowledge.	Users do not have the required skills to perform the desired actions.
Context	Work environment facilitates the interaction user-technology.	Work environment does not provide adequate conditions for user-technology interaction.

**Table 2 - Framework guiding Potency Analysis**

Data quality analysis was based on the assessment of two dimensions: Completeness, understood as the extent to which all expected and required data (records, attributes) are present or not missing, respectively (ISO 2008); and accuracy, the degree of agreement between data and real-life phenomenon under study (ISO 2008). For this purpose, two sources of data were contrasted: i) the actual data from the HMIS collected on paper during the four months before the deployment and data collected with the tablets during the four months of the project, and ii) a retrospective data entry of the same 8 months that was done manually using the same book source used by the health workers in their daily operations. In summary:

- **HMIS Data:** The comparison of completeness of data indicators for a period of 4 months before and 4 months after the deployment. This process allowed us to compare manual calculations and data entry with automatic aggregation and synchronization.
- **Baseline Data:** Data entered in HMIS before and during the deployment (8 months) was compared with a baseline retrospective data entry (8 months) manually collected by the first author. This data would serve as a reference for the accuracy of the project data before and after the intervention.

The indicators used to analyse completeness were those who could identify gaps on the records: Number of Patients discharged without diagnosis, Number of deaths without cause of death, Number of deaths without time of death from admission recorded, Number of admissions without birth weight recorded (for Neonatology ward and Nutrition program only). Those used for accuracy were related to volume of activity in the ward: Number of admissions, Number of exits, Bed Occupancy Rate and Average length of stay.

## Case Findings, and Analysis

This section describes the analysis and findings structured around four identified affordances. The analysis is presented in two steps: i) the work practices and the perceptions of users on the comparison of the working of both systems; and ii) analysis of both systems based on the potency framework. The four identified affordances are: i) collecting patient data daily, ii) aggregating data weekly, iii) managing ward logistics, and iv) accessing patient historical data.

### ***Collecting patient data daily***

This process starts with the patient file as the source of information, where each patient is registered in the registry book during admission and patient details are updated and completed at discharge. These two steps happen in the ward, where the medical doctors complete the patient file and the nurse supervisors and medical officers complete the registry book on numerous occasions during the day, intertwined with the medical and operational activities. Users saw the purpose of the registry book to simplify the posterior weekly aggregation process in an easy-to-read format. *“Counting all the figures reported from the patient clinical file did not seem a feasible option since it had a lot of information and was not well structured. Objectively the registry book is to, at the end of the week, come out with the epidemiological week data collection”.* (Nurse activity manager)

When users were asked to **compare the paper and the tablet**, they all preferred entering data only in the tablet, which they found very intuitive, fast, and easy, while improving data quality. *“I’ve been observing national staff using it and I don’t think they have any difficulty... maybe... they take a bit of time, but I think is a matter of practice, I think is ok, even for national staff...”*. (Nurse activity manager)

They also referred to the data being more complete on the tablet, which required less information, prompted you to enter the right information through dropdowns, and highlighted forgotten fields. *“Sometimes we don’t complete the book, because not everything is required”*. (Nurse supervisor)

Interestingly, none of the fields were mandatory in the tablet, despite user perceptions of it being so. During design, we had explicitly decided not to make fields mandatory, as being too restrictive could become a barrier for data entry. We just trained them to complete the form which had some prompts and validations and could perfectly be closed while having empty fields. The quantitative analysis, however, revealed an improvement on the completeness of records. The sense of required completion seemed to be caused by the fact that information was already digitalized, but nothing on the technology was forcing them to do it.

Concerns about access to data on the tablet were common. National staff did not want to extend the mobile data collection to other health staff in the ward, like nurses or clinical officers, as they were worried about changes or deletions in the data or wrong data entry due to a lack of attention. During the deployment of the tablets, they requested us to put a password on the tablets to restrict access arguing that they wanted to protect the data from use by other health staff. What made this interesting is that all users have access to edit and modify the records in the book, it is true that is difficult to lose data from the book –unless you physically lose the book or tear off one page- but errors in data entry can equally happen. Again, it seemed like the digital component made users more protective of the information. Some other users, however, expressed more trust in the permanency of data once entered the tablet, since the book was exposed to physical incidents. *“In the book we can lose the information, but on the tablet, we will always have it. The book can be torn, water can be spilled”*. (Nurse supervisor). In practice, it was easier to lose data on the tablet than in the book because it could be deleted or modified.

Some users preferred the flexibility of the book because they could write more locally required information using the margins or registering, for instance, two diagnoses instead of one. The HMIS collected only one main diagnosis per patient, but sometimes it was useful to look at the book and have more clinical details. During deployment, users considered it impossible to completely replace the book with the tablets but were more positive about the possibility post-deployment. After working with the tablet for four months, the use of the book was seen as redundant and therefore replaceable: *“...with the data from the tablet and the data of the patient file we can still work 100% without having the register, I don’t need to have the register”*. (Nurse supervisor)

However, replacing the book implied involving more people in data collection to cover for night shifts and weekends. The book was operated by nurse supervisors, nurses, and clinical officers, while the tablet was operated only by the nurse supervisors and the data collectors, who did not work on night shifts. There was reluctance to extend tablet access to all staff because of their perceived lack of IT literacy which would adversely affect data quality.

### **The potency framework analysis for collecting patient data daily**

Both systems operated in the same **context**, where data entry, either in the book or on the tablet, would happen in the ward, during working hours, and in parallel with the regular medical activity.

The **system features** of the tablet were very well accepted, and users preferred that to paper for data collection. Users had no difficulties in using the mobile device and registering a digital form, with an instinctive willingness to complete all the fields – thus enhancing data completeness. The main concerns were related to the possibility to lose data because it was deleted or corrupted, while the book seemed more robust and under local control. On the other hand, some users found the book more susceptible to damage, such as rain and physical loss. Users liked the flexibility of collecting more data in the paper book, even if was not later used for weekly reporting. Most users were positive about the idea of replacing the book with the digital but raised the need for more training. When asked about replacing the book with the tablet, they were all in favour, but if supplemented with more IT training.

The **user abilities** required to operate the tablet were more demanding than the paper but were not perceived as being unrealistic or too high. In principle, all the medical staff knew how to read and write in

the book, but the familiarity with technology was diverse as some found manipulating a mobile device very challenging and requiring training.

### **Aggregating data weekly**

Every week, the books are taken to the nurse's office, in the hospital, for the manual aggregation process. Usually, on Monday morning, the nurse supervisors, with help from the data collector when available, count all the patients of the prior week to calculate the necessary numbers required for posting to the weekly aggregated reporting form. At the end of the day, once the paper form is completed, it is taken to the project office, where the data collector or nurse activity manager enters the data into the HMIS for its validation and consolidation to the central database.

The reporting day was very hectic for the nurse supervisors because they needed to take stock of the past week while continuing their everyday tasks in the wards. While taking stock, they may identify discrepancies in the numbers, which they need to diagnose and correct. In many cases, making this rectification is problematic as the original source of information is no longer easily accessible because the patient has been discharged. The manual aggregation process took about 4 hours, during which the wards also needed to be operational, while the nurses would constantly be interrupted by different requests and work. In busy weeks, this process could be delayed by three or four days, which in a weekly reporting system, was significant.

When asked about **comparing the book with the tablet** for the weekly aggregation process, there was a strong consensus that the tablet helped them to save time. It was highly appreciated not having to review the data from all the previous week on Monday mornings. *"I prefer the tablet because is easy, you enter the patient, the discharge, everything, then you don't have to do the tally sheet again"*. (Nurse supervisor)

The positive impact of the tablet on the data quality was highlighted because data was entered during the process of admission/discharge while the memory of the information was fresh, and users did not need to remember on Monday the details from the last week. Previously, on Mondays, the users might not remember pieces of information and would need to go back to the patient file to check some fields (for example a missing field, an unreadable handwritten diagnose or name), which was cumbersome and prone to errors. The quantitative analysis of data confirmed this by showing an increase on data accuracy. Some users also mentioned data being more complete when they used the tablet. *"When I do here (on the tablet), I report directly, and I don't have to come back. In the book... on Monday, I don't remember what I recorded... When I enter in the tablet it is fresh"*. (Nurse supervisor)

Most users expressed greater trust in the weekly numbers generated by the automatic aggregation from the tablet than when manual calculations were used. *"I trust the tablet data more than the manual. We do it with attention most of the time but is very easy to miss information and I don't remember well the information"*. (Nurse supervisor). However, some other felt that the aggregation results from both systems were equally reliable. *"Tally sheet I know by looking the book, and I make no mistakes. The result is the same; there are no errors in the tablets and no errors in the tally sheet"*. (Nurse Supervisor)

### **The potency framework analysis for weekly reporting aggregation**

In terms of **context**, the new solution only required the launch of an automatic process, which was done on the laptop at the project base office, far from the hectic activity of the ward in the facility. The manual aggregation was performed in the medical office at the hospital, where nurse supervisors were accessible and reachable to respond to any situation in the hospital ward which required their attention.

In terms of the **system features** and **user abilities** required, the tablet seemed to be the overall preferred solution, as it allowed for data being collected closer to the time of recording where the medical action happened and didn't require any further steps more than clicking a button to trigger the automatic aggregation. This stood in contrast with the long manual process they had to perform without the tablet, which was very slow and prone to human errors. The time saved for health staff was the biggest benefit identified by all participants, who also felt the additional IT skills required were minimal.

## **Managing ward logistics**

The registry book was a key component for day-to-day ward management. Its functions go beyond the original objective (having an easily accessible registry of admitted patients that helps to generate weekly aggregates for HMIS reporting). The register was used to follow up on patient movements in the ward, check every morning who was admitted and verify bed numbers, identify new admissions when they were not in the book, or even calculating the food required for patients or caretakers and the management of stock of bed sheets and mosquito nets. *“They follow the ward with the book... and the book with the ward... They also count the caretakers to estimate the food they need”*. (Project medical referent), *“... the register is almost 75 to 80% used for data, for HMIS. know the remaining 20%... it can help the nurse follow up the patients... whenever they are going to give the medication... they check the name of the patient ...”* (Nurse supervisor) *“... If I count the patients in the book and the patients in the ward, I can know that there is a new admission...”* (Nurse supervisor)

On **comparing the book with the tablet**, users said that they felt less comfortable following up the ward on the tablet, as it was easier to have a quick overview of the ward for basic management by checking the patients in the book. Also, the registry book presents a snapshot of patient demographic, clinical and nutritional status, and data was easily accessible only by opening the book, while the tablet involved multiple clicks. *“... seeing the list in the book is easier than the list in the tablet... is better with the book, because is easier to read information in the book. I see more in the book”*. (Nurse supervisor)

The users highlighted that key information like the name of patients or the bed number, which are crucial for the ward management and patient follow-up, were missing from the tablet, making it impossible to replace the book. *“If we had the same information that we have in the book on the tablet, then you just need the motivation to do it”*. (Nurse supervisor). From the designers' point of view, this was deliberately omitted given that data like patient names or bed numbers was not required for epidemiological reporting and going through data security regulations would have added unnecessary complexities to the project.

Like other affordances, replacing the book with the tablet would imply the involvement of more staff in the digital data collection process, because of the night shifts or weekends involved. And again, we found reluctance to involve other medical profiles, like clinical officers into tablet use. *“... Not possible, I would not accept. Right now, there is more information in the book. The tablet might not be used by everyone, I want the COs (clinical officers) to work on the book. In my absence, they will work on the book, and I will update the tablet”*. (Nurse supervisor)

### **The potency framework analysis for managing ward logistics**

Managing the ward with either the book or the tablet was done physically in the ward. Both systems operated under the same **contextual** conditions. Management-related activities were done several times during the day as part of the regular ward work practices.

In contrast with the previous affordances, the **features** of the book seemed to be more suited for supporting ward management. The book offered a clear list of patients admitted to the ward with bed number, name, and status (admitted, discharge), required to perform basic management actions. The tablet, however, displayed a list of patients that could be filtered based on their status (admitted, discharged) but did not have personal identification of patients (patient name) or the bed number.

In the book, all information was presented on one page of paper and could be viewed in one sight, for example, to see if patients were admitted or not by looking down one column. On the tablet, the list of patients did not automatically display that information and users had to apply a filter to see which patients were still admitted to the ward. Users felt more comfortable reading the information in the book than on the tablet.

In terms of **user abilities**, with the book the user only needed to open it, read, and make simple mental calculations. With the tablet, they needed to know how to use the application to filter the patients and feel comfortable compiling information on the digital screen, which was not often the case. The book answered better to the functional needs and users' skill sets.

### **Accessing patient historical data**

The book helped users to find information about a patient who was re-admitted. Even though the book had very limited information compared to the patient clinical file, field staff admitted using the book and very rarely going back to the clinical file, because *“it was more difficult to find an old patient file than a registered entry. ...also, we want to check the book sometimes when there is a readmission. Then we go to the book and check the name of the patient. That the patient is with us before. So, we check the book, and we check the diagnosis, and we compare it”*. (Nurse supervisor)

Comparing **the book and tablet** for finding information on an old admission, the book was clearly preferred. The tablet did not have the patient’s name, which made it useless for this purpose. In the book, data was written chronologically, and to search for past information you just needed to pass the pages looking for the previous ones. On the tablet, to look for old records the users needed to filter by date: *“I prefer the book because I can look for the patient. On the tablet, there is no name there. I cannot search for the patient”*. (Nurse supervisor)

Access to information was also found to be a limitation since the tablet was not always in the ward. During the night shift and weekends, the tablet was at the project base: *“The book is important to search for past information. The tablet is sometimes taken to bravo (project base office) and then we will have nothing to record the patient. The book is always here”*. (Nurse supervisor)

### **The potency framework analysis for accessing patient historical data**

The lack of patient identifiable information like name, was a major limiting **feature** of the tablet. In addition, it required more IT-related **user abilities**, not only because it required the user to feel comfortable reading data/information on a digital device, but also because they needed to know how to perform a search based on dates to navigate past data. Both systems operated under similar **contextual** conditions, with this activity being done occasionally as part of the regular ward work practices, every time a patient was readmitted.

## **Discussion & Contribution**

The main purpose of this analysis is to develop theoretical understandings of how humanitarian workers use and perceive digital technology when introduced into their everyday work routines. To do so, we analysed how new mobile technologies impact the data collection processes, in relation to existing paper-based solutions, an enduring aspect of humanitarian health work. New digital interventions must inherently contend with the “competition” provided by the existing manual systems, which remain deeply integrated into the work lives of the health staff. For this reason, we have studied users simultaneously exposed to both paper and the digital solution to answer the research question: *How do competing affordances of paper and digital technologies shape practices of data collection in humanitarian settings?*

Our analysis was informed by the perspective of “competing affordances” which allowed the study of, one, the nature of affordances enabled through the paper and mobile-based systems, and two, the situated potencies perceived by the health staff when both these systems played out in combination in the workplace. This analysis was based on comparing the potency of the competing situated affordances as they played out through the interaction of user abilities, the work environment, and the system features.

The four affordances identified through the information practices analysis were: (1) collecting data daily; (2) aggregating data weekly; (3) managing ward logistics and (4) accessing patient historical data.

To interpret the situated potencies of each affordance, we summarized the three determinants of potency – the abilities of the users, the system features, and the work environment- and interpreted them as “strong” or “weak” based on the perceptions of the staff gathered during the interviews and observations. We further compared the combined potency of these two systems as they played out in practice.

For the **collecting patient data daily** affordance, the strength of the potency was quite balanced, with the new system being valued and preferred over the paper.

Users found that entering data on the tablet on the same day when the medical event happened improved the quality of data because they clearly remembered the details, however in the paper-based existing system, they write down the information at the same moment. This means that information is equally fresh

for them, with the difference that with the paper-based system, they have to come back to the data on the following Monday to review and count all the information, for their weekly aggregated reporting. Digital data collection done closer to the context of the medical action was seen to be more “granular” because data was digitized at the individual patient level, instead of after the retrospective aggregation at the end of the week. Data took on a more “permanent” and trustworthy nature through the entering of it into the digital device, without requiring further manual processing. This process also enhanced perceptions of the completeness of data. Although both systems collected the same data at the same time (except details of patient identification which were only on the book), and no fields were configured as mandatory in the tablet, data was perceived to be more complete and accurate in the digital system. The quantitative analysis confirmed improvements in both completeness and accuracy of data. The need for IT skills or training was felt required to enable effective use of the tablet, but the potency for data collection outweighed the use of the paper system.

A significantly stronger potency of the mobile application was seen over paper concerning **aggregating data weekly** due to the ability to automate the aggregation process avoiding the need for retrospective manual aggregation using multiple tally sheets on Monday mornings. This was seen to be timesaving and more accurate, even though the tablet involved repeating the entry of patient details first in the patient book and then in the digital system. However, the gains through digital aggregations outweighed the double-time taken in entering individual patient records. Some users defended the process of manual aggregation, while project coordinators were unanimous in their trust of the digital process over the paper. This was confirmed by the data quality study, which showed more accuracy on data items that required complex calculations like bed occupancy rate, or the average length of stay. Overall, the potency of the digital system was superior to the paper, and even stronger acceptance was perceived of the higher value to be gained if the mobile devices would completely replace the paper-based system.

In **managing ward logistics** and **accessing patient historical data**, both the affordances were perceived to have inherent system-generated constraints, more for the new system. Since the digital system did not store key data on the patient’s name or the bed number, not required for the weekly reporting of epidemiological data, it became cumbersome for users to retrieve patient data which was important for them to support their clinical work. Further, reading on a screen and using features of searching and filtering was not as comfortable and natural as scanning the paper on the columns having patient details and finding what was needed. While these two actions were not part of the data collection process itself, they were crucial in supporting the practice of everyday clinical work in the wards. There was thus negative or weak potency to these two affordances for completely replacing the manual process with the new digital system. A firm recommendation from users was for the further development of the mobile-based solution, to include this patient information.

Table 3 below, summarises the potency analysis per affordance and influencing factor. In summary, while the digital system showed strong potency for the more expected practices of data collection and aggregation, it was seen to be weak for unplanned and emerging practices of ward management and accessing patient records. This finding has important implications for the adoption of technology for strengthening humanitarian action, which by its nature is unplanned and emergent in context.

Affordance	Potency Factor	Paper- based System	Mobile-based System
Collecting data daily	System Features	Weak	<b>Strong</b>
	User Abilities	<b>Strong</b>	Weak
	Context	Same	
Aggregating data weekly	System Features	Weak	<b>Strong</b>
	User Abilities	Weak	<b>Strong</b>
	Context	Weak	<b>Strong</b>
Managing ward logistics	System Features	<b>Strong</b>	Weak
	User Abilities	<b>Strong</b>	Weak
	Context	Same	

Affordance	Potency Factor	Paper- based System	Mobile-based System
Accessing patient historical data	System Features	<b>Strong</b>	Weak
	User Abilities	<b>Strong</b>	Weak
	Context	Same	

**Table 3 - Summary of Affordance Potency Analysis**

We saw that the prevalent solution will always be that which requires a behaviour akin to that -from the original definition of affordances from ecological psychology- of an animal who perceives the object in terms of what it affords which does not require an explicit cognitive process (Gibson 1979). We observe that deploying new systems in humanitarian settings, similarly, needs to be friction-free and easy to use, just like an apple to be eaten by effortlessly being plucked from the tree. Maybe such a state of use is unattainable when compared to paper which naturally is intimately integrated into the work lives of the health staff on the ground. But the situated affordance potency, however, has been relevant to identifying important affordances and their respective potencies as seen by users. The “competing affordance potency” framework has revealed the importance of being “proximate” to such a routine use of the technology.

Our work contributes to IS research by engaging with the development of context-specific theorisation of IS use (Burton-Jones and Straub 2006, Hong et al. 2014). We do this by determining the potential actions the IT artefact enables for the actors and its actualisation in the situated settings (Burton-Jones and Volkoff 2017). This study provides two key theoretical contributions. One, we contribute to the affordance potency framework by assessing its feasibility for studying technology adoption within the context of humanitarian intervention and extending it through an application of a practice-oriented analysis of affordances. Two, we use the proposed framework to examine the notion of “competing affordances”, which builds upon earlier studies where only one digital intervention is considered. This analysis is useful, as there are always processes of change involved from the old to the new, and competing affordances are inherent to the process. Bringing in the perspective of competing affordances, since paper is always here to stay, provides useful insights into IS research, which typically has focused on studying the affordances of the new system being introduced in isolation from what already exists. This then contributes to the broader research field of IT-enabled organizational change.

New technology may offer many opportunities for humanitarian action, but it also presents several challenges. Finding the balance between the introduction of these new systems to improve quality and facilitate accountability and, the capacity of the organizations to adopt them and add value is crucial. This work enabled the authors to provide insightful recommendations to the organization and helped build trust in mobile interventions for improving data collection processes. Our study shows how the introduction of this new technology overcomes the challenges presented. Users save time in collecting data that helps them devote more time to caring for their patients; the quality of data has improved, mainly impacting crucial indicators for the management of the medical wards, and overall, trust in data and technology as a trustworthy medium has increased.

The mobile data collection project has successfully evolved and, at the moment of writing this paper (April 2022), a second version of the system has been running for 11 months in the same setting. The new version includes improvements identified from this research such as incorporating patient data and making more intuitive actions required to filter and search patients. MSF Spain is, in a parallel process, assessing the feasibility of scaling this technology to their missions in other countries.

## Conclusion and future work

The perspective of competing affordance potency in technology adoption is valuable in the context of humanitarian settings and revealed the importance of the natural use of technology. The variety and dynamicity of users in constant turnover, who are, in addition remotely based, raise particular challenges in technology adoption and value-adding needs (Kabra et al. 2017). If the use of technology does not fit smoothly into their day-to-day activities, it is likely that eventually users might find their own solutions and end up using a different software or not using technology at all (Kabra and Anbanandam 2016). Understanding how a strong potency can be provided increases the likelihood that users will actualize the existing affordances, hence, using the system for its purpose.



Limitations of this research are, firstly, the challenges and benefits described have been identified in a specific context of health services in the facility, with a moderate volume of patients and where data collection processes were already underway and therefore, its recommendation cannot be extended to other type of projects. The suitability of the competing affordance potency framework could be strengthened by further studies in services with a high volume of patients or emergency projects, where the urgency in the provision of medical care already competes with any other non-medical activity such as data collection; or in out of the facility projects such as community activities, where the data management processes are not as solid. Secondly, some of the benefits perceived by the users, such as time savings in data collection, could not be objectively quantified due to the nature of the work in the medical ward, where those in charge of entering data on the tablet were constantly interrupted to assist with the medical tasks. Lastly, one of the main potential benefits of using this tool, the collection of individual data as an electronic health record, was not studied as it was out of the scope of the field intervention.

Findings revealed a potential shaping of a hierarchical system among different medical roles when mobile devices were introduced in the ward. We also observed an apparently instinctive willingness to complete all the fields required in the form and to pay more attention to the data when digitally registered. The scope of our work did not allow us to further engage on such socio-technical aspects which we believe might also open a very interesting area for future contextualised research.

Walsham (1995) has argued that there exist different modes of generalization from interpretive work, where concepts, insights, and theories can be derived and applied in other settings. Walsham provides the example of Zuboff's insight of "informaté" derived from an interpretive case study, which has found widespread use in different time, space, and work contexts. What we offer as a potential means of generalization from this study, is the insight of "competing affordance potency" and a possible methodology on how it can be interpreted, which we believe can help strengthen IS implementation work not only in other humanitarian settings but also other IS intervention sites, more broadly.

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