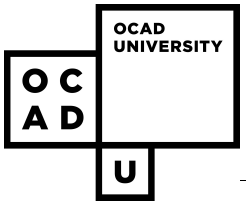

2013

On the role of systems thinking in design and its application to public self-services

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Abstract

This paper uses the paradigm of e-accessibility, and in particular the application of publicly available self-services in order to demonstrate and discuss the power of a Systems Thinking perspective in Design, and more specifically in the design of services. Our aim is to present some justification as to why employing systems thinking can help designers to identify and acknowledge holistically the dimensions of problem space for which they are required to design. The richness of the approach will be discussed, through some theoretical tenets of systems thinking, such as the use of the emerging properties, and the law of requisite variety, notions of second order cybernetics etc. in the conceptualisation and praxis of design.

Introduction

In brief, Systems Thinking came about in response to the failure of mechanistic thinking and vitalism to explain biological phenomena. In systems thinking, a 'system' is a complex and highly interconnected network of parts, which exhibit synergistic properties, where the whole exceeds the sum of its parts The living organisms are, as far their organisation is concerned, closed systems, while at the same time, as far as their energy is concerned, they are open, with incoming and outgoing energy and matter. That is, they are not ‘idle’ or ‘immobilized’ in their immediate surroundings, and are studied as a total entity. In this way, they present emergent properties, which cannot be deduced from their component parts (von Bertanlanffy, 1974; Flood & Jackson, 1991).

Apart from its application to the study of biological systems, systems thinking plays an important role in the world of management and organization (Flood & Jackson, 1991), while of course, systems theory in

general, has been used in engineering and engineering design for many decades (Sage, 1991). However, it is acknowledged that the real power of systems thinking is in dealing with the high complexity of ill-structured problems (Checkland, 2000) that are traditionally human-centric (Ackoff, 1974, Bausch, 2001). Considering the above understanding, and in keeping with the pioneering work of contemporary design thinkers who are promoting the use of systems thinking in design, (Arnellos, Spyrou & Darzentas, 2006, 2007; Charnley & Lemon, 2011; Darzentas and Darzentas, 2013; Jonas, 2007; Nelson and Stolterman, 2002; Sevaldson, 2010; Valtonen, 2010) we speculate here on some cases of designing for accessibility.

The exemplar

The problem of designing for accessibility is not new. It means that the design of products, systems and, indeed, the built environment, does not exclude people with disabilities. We are familiar with architectural accommodations, such as elevators or ramps in buildings that facilitate those who use mobility aids, such as wheelchairs. They also benefit people who need assistance: those with temporary disabilities, for instance using crutches; or those carrying heavy loads, or those with children in push chairs. This kind of accommodation is also extended to include eAccessibility which includes the accessibility of web content; of content offered by digital television; of services offered by self-service terminals. The eAccess+ network, (2010-13) was set up to investigate and report on the accessibility problems encountered in the use of these services and ways to overcome those problems.

For the purposes of this paper, we concentrate on the type of public services that are most commonly available via self-service technologies. These services range from the simple, such as the purchase of a train ticket, to increasingly more complex interactions, such as filling in forms or obtaining customized information. These services can be accessed and delivered via self-service terminals (SSTs) available in public spaces. However, they are now increasingly available online via an individual's personal devices (desktop, laptop, smart mobile phone or tablet). An example is the self-service check-in machine at airports, or the equivalent 'web check in' that people can use by connecting to the application with an internet enabled appliance.

We consider these to be representative human centric design problems for independence and autonomy. Our particular area of concern is the provision of these services to vulnerable people. With the term "vulnerable" we include:

- older people,
- people with sensory and/or mobility and/or dexterity impairments,
- people with cognitive impairments

- people literacy problems, such as economic refugees, who may understand, but not read the language of the host country,
- people in handicapping situations, such as a parent with a small child, an adult child caring for elderly parent

The increasing numbers of vulnerable people is an acknowledged problem. Statistics for Europe, (Eurostat,2012) for the percentage of the population who are over the age of 65, show that this is a population reaching as much as 20% in Germany, and is predicted to rise. This means that more of the population is living with age related disabilities. Added to this, is the global movement of populations because of war, famine, economic downturn and climate change that is increasingly fuelling the economic refugee situation (Eurostat, 2011). Most countries in the 'developed world' live in a service based economy, where services operate in many different contexts (Glusko, 2010). At the same time, many countries are now requiring their citizens to use online and unmanned services, and are withdrawing traditional face-to-face services. For instance, in 2013 Greek citizens were required to submit tax returns online, the paper based forms are no longer accepted (GR Reorter, 2013). This increase in technology mediated self-service (Datatrend, 2009 Holman & Buzek, 2012) in the public service sector implies dependence on SSTs or personal access to internet enabled gadgets. Yet, for the most part, these are out of reach for vulnerable populations either because of technological or economic barriers. Thus reliance on this type of service can signify difficulties or even exclusion from direct access to services for large sections of the population.

Applying Systems Thinking

Current approaches to dealing with the accessibility of public services, and promoting the inclusion of the vulnerable are mostly based on an extended human-centred and human computer interaction research. This leads to suggestions that are not implementable, or even if they are, are not completely effective, because reality has been treated in a piecemeal or reductionist manner. As an example, guidelines pertaining to the optimal height of screens for ATMs have led to a plethora of accessibility related standards that are contradictory amongst them, and none of them really tackle key issues. It is our belief that a systems thinking approach offering more far reaching and deeper thinking is far more appropriate.

Some properties of designed systems with SSTs have eventually been identified, or at least, given more importance, mostly via costly trial and error. We contend they could have been in the designed system from the beginning if systems thinking had been used to drive the problem identification, understanding, and modelling. As an example, in ATM design, the overriding importance of the property of "privacy" is now being given more prominence. What this results to is that the design and locating of an ATM should accommodate customers' need for privacy. In systems thinking terms, this property would have emerged as part of the *customers subsystem* whose relationships with subsystems such as

ergonomics; location / allocation and *spatial architectural* to mention a few, could have made the properties of privacy and safety surface at the outset of the design process, and before implementation of solutions. As it is, although ATMs have been in existence for many decades, it was not until recently that designs gave emphasis to this need for privacy (IDEO 2010).

In another example in the financial services world, a local bank manager and his superiors decided they needed to install more bill payment machines inside the branch bank building because of the high volume of use and the subsequent customer queues. However, just "throwing more machines at the problem" created many new ones, each having a set of consequences. For example, installing more machines meant that the space inside the bank was further restricted, and the waiting areas became more cramped. This led in turn to removing most of the customer seating. This was especially resented by the older members of the public. As a result of the conditions, some customers decided to take their custom elsewhere, so as to avoid the unpleasant situation. The number of customers was reduced, and possibly the need for the extra machines also reduced.

However this was not the only consequence. Installing new machines also caused problems to the operation of the bank. For the bank managers, the new SSTs obstructed their line of sight. This was important because an essential duty was to monitor the minute-to-minute assignment of staff and to direct staff positions. Staff are regularly deployed to different tasks depending upon demand, and directed to go to where they are most needed at any given time during the day: for instance moving between teller stations and customer query stations. As a retrospective 'fix', the designers installed CCTV (Closed Circuit Television) cameras trained on the positions of each member of staff, so that the bank managers could continue to monitor operations. However, this is a one-way communication system, so staff were no longer able to communicate non-verbally with their superiors, as they had done when they had reciprocal direct line of sight. This had meant that they were co-responsible for the need to move: they had seen the problem, could anticipate deployment instructions and already prepare to move to where they were needed. Furthermore, the CCTV cameras gave them the feeling they were being "spied upon". This led to resentment and bad feeling between the staff and manager and demands that the manager agree not to make use of the cameras. The whole story of this design intervention therefore represented, not just a loss of time and investment, but damage to staff–manager relations.

Thus, as can be understood, many new problems were created, that were more serious than those they had set out to fix, leading to increasing the disruptions in the bank's operations and both bank-customer relations and staff-management relations rather than just solving the issue of more billing machines to meet demand.

We contend that had a systems thinking approach been used, and had the problem been treated as a system, rather than seen as an isolated problem of needing more SSTs to satisfy demand, these problems could have been avoided. Systems thinking would have brought up these requirements and conflicts much earlier. In that way it would have given the design problem dimensions of understanding both when and where it would have been really useful to know, before implementing "solutions".

Discussion

In Systems terms, considering the particular problem area and treating it as a system, means that its human-centric character will be given priority and rich pictures will result from the attempts to understand it. Such proven systems thinking approaches and methodologies can then be applied to continue the process of understanding the 'real' design problem space and in this way contribute with solutions.

Furthermore, systems thinking will also help designers to sustain the richness required for providing robustness and acceptability, i.e. producing something which relates to the actual problem, and aids its proper use. For instance, if designers are systems thinkers they will be actively looking for *emerging properties*, they will try to incorporate these in the design solutions. Again, designers who are aware of systems thinking will understand the need to uncover and 'import' the complexity of the design problem. They will, as well, acknowledge the need for *requisite variety* (Godsiff, 2010) to provide the necessary power to confront and deal with as many situations and conditions of use as possible. This can only be beneficial to the final designs. Awareness of the notion of 2nd order cybernetics should also help designers to ground their own role in the process of design. Briefly, they are aware that they are part of the problem and part of the solution, and not observers, and can account for the influence this might have.

From the perspective of designers, *complexity* should be welcome because of the richness it offers. Designers, instead of operating in a reductionist manner, can adopt the view that the more complex a system appears to be the 'healthier' it is, because if understood, it offers more ways to deal with problems than a less complex one. Again, the notion of '*Variety*' can be seen in a similar way. In cybernetics it was introduced to measure the potential of a system to defend itself against external threats or interference in the sense that only variety controls or defeats variety.

Thus, in the case of the design of service in general and self-service based technologies in particular, systems thinking designers will possess the thinking tools and knowledge to add in to their methods. For instance, these would help them to seek for and determine the variety of service demands. They will know look for the variety of services that should be provided and of course what the SSTs should be able to deal with. For example, in our case of the accessibility needs of vulnerable people, including those with a disability, but also non-native speakers, for whom using a self-service kiosk may be difficult, or even impossible they will increase the variety. As noted by eAccess+ (2010-13), some of these problems are:

- Wheelchair users may not be able to get close to the controls of the kiosk
- For partially sighted users, the print on the screen or the buttons may be too small or without sufficient contrast
- People with literacy problems or older people may find that kiosks time them out, because they need longer to make the decisions asked for by the kiosk software

Following the law or "requisite variety" such needs, if recognised, can actually offer creative opportunities for designers that enhance the usability and accessibility of the SSTs and the services for everyone.

Conclusions

This paper adopts the thesis that every artifact which results from design praxis, coexists with the resulting overall service design. This is how the example used here, i.e. self-service, is considered being systemically designed as a service design, designed together with the 'touchpoints' (Bitner, 2001) of the system such as the SSTs or other delivery mechanisms .

We believe our example case of accessibility highlights the importance of the use of Systems Thinking. Particularly in the case of accessibility of the self-services, there is an irrevocableness that cannot be denied. Technology for public use, if designed appropriately, has the power to enable many vulnerable people who otherwise cannot participate in and enjoy these services. It is also a paradox that these systems are, perhaps, of more use to people who cannot easily use systems in a traditional manner because of, for instance, difficulties in mobility. On the negative side, badly designed and inaccessible technology and services also have the power to further disable, disenfranchise and reduce their autonomy if not designed in a holistic manner. Using systems thinking to deal with this problem, directs designers to consider accessibility needs as a result of utilizing notions such as requisite variety and emerging properties. It offers them the opportunity to make the accessibility, usability, and ultimately the usefulness of self-service systems more representative of all citizens' needs.

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