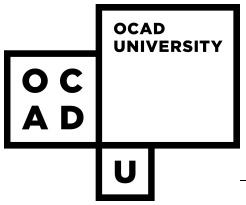

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Systems thinking for design thinking.

Darzentas, John and Darzentas, Jenny

John Darzentas, Jenny Darzentas

Systems Thinking for Design Thinking, Towards Proposing a Generic Approach to Design

Abstract

This paper presents an initial argument regarding a Systems Thinking based methodological approach to Design Thinking and Praxis. It proposes that the Design problem space should be captured and expressed as a system, in order to use Systems Thinking to help formulate the design brief and subsequent design interventions. In this way, Designers will benefit from a perspective that allows them to deal with situations of complexity. Capturing and structuring the design space as a System can be supported by tools, techniques and methods that are already familiar to designers, the importance is to use them in a new way.

Introduction

In the world of Design we see an increasing involvement of Systems Thinking (Nelson & Stolterman, 2012; Jones, 2013; Ryan, 2014; Sevaldson, 2011). There is an acknowledged understanding regarding the holistic view of design problems and the realisation that as much as possible of the whole of the problem space should be considered from the initial stages of tackling it. However, in addition, there should be systemic proposals as far as design praxis is concerned in terms of methods and methodologies. There are, of course, suggestions from the abovementioned thinkers and others as to how such approaches should be adopted to Design Thinking by acknowledging and including the use of Systems tenets and principles in general. Also the adoption of existing Systems methodologies, mainly from the world of management, has already been suggested (Ng et al., 2009; Molineux & Haslett, 2007). It is now perhaps an appropriate time for Systems Thinking approaches to Design to be formed.

This paper attempts to present a generic proposal for the systemic tackling of design problems, both by utilising systems tenets which can be treated as basic design principles, and by concentrating on the capturing and forming of the design problem space. An important concern is 'how' this space is expressed. The arguments as to 'why' there should be effort to adopt Systemic Thinking need also to be marshalled, and this is undertaken next.

Attempting to justify, yet again (Darzentas & Darzentas, 2014) the question of "why Systems?" we have come to realise that perhaps an interesting way to reply is to explain our personal trajectory. In our case, on one hand, a journey from Mathematics to hard Operational Research (including Statistics and Simulation), to Soft OR, Systems Thinking, and Human Computer Interaction and now Design; on the other, Humanities to Human Computer Interaction, led both to the realisation that, through living and growing, we acknowledge positively the creative 'trouble' in problem description and understanding. That is, when applying knowledge to real world applications, moving from being:

- contented with disciplinary thinking and praxis tools, solving complicated problems assumed definable but requiring a number of assumptions to be satisfied. The main tendency being simplification.

To:

- coping when moving into more specific domains that even from the outset could be called multi/interdisciplinary domains, but still treating their problems as complicated and simplifiable mainly by adopting reductionism.

Then to:

- embracing the real world of interwoven multi/interdisciplinary problems, where problems are now really complex, basically because they are human centric and not the 'neater' complicated engineering ones. The main characteristic is now the move from complication to complexity

It has taken quite an effort in the last decades from all those involved with complex human-centric problems to admit that complexity is a useful thing and must be welcomed and not be 'bulldozed' out of the problem space.

Design, as a representative domain of the complex world of problem solving, is evolving in an exciting way, but as every other discipline which must solve problems, it is always challenged by reasons to apply reductionism. Systems Thinking, on the other hand, works with the 'holon' which cannot be defined nor easily co-exist with reductionism. In terms of a Design problem, it means that if reductionism is imposed then the problem tackled -.while it may be of the real world - is a different one from that represented by the whole, and misses out a lot of the actual problem space.

Another way of looking at the issue may be through the affordance of the particular design project results, be they tangible or intangible. It could be said that their affordance could be very different in the case where the Design problem space is considered as a whole, from when reductionism is applied. To illustrate this, we have discussed the case (Darzentas and Darzentas, 2014) where it was decided to position more bill paying machines in a bank to alleviate the problem of long queues to use the existing ones. Although, ostensibly this was done to reduce customer frustration and thereby gain customer loyalty, the decision to put more machines into the existing space caused disruptions to operations and reduced the space for customer seating. Thus the expected result did not materialize: the affordance of more machines mislead customers and bank managers alike, and in effect increased frustration and with that lost the bank more customer loyalty.

The proposal here is concentrating on capturing the problem space as a System and on structuring that System, and it is our position that this is the front line to successful design interventions and that ideas of Systems Thinking have special distinct ways of supporting Design Thinking.

Systems Thinking For Design Thinking

Design Thinking currently uses participatory approaches to co-design with stakeholders. Typical examples are emerging everywhere where there is the relatively new challenge: that of Service Design which brings with it the very real and revealing quality of being intrinsically human centric and complex, and in many cases expected to bring about results that are

'socially innovative'. Currently, a stock set of tools and methods are used, such as *customer journey mapping* and *service blueprints* both derived from management approaches, but most methodologies are collections of tools and methods and frequently lack a methodological framework of their own to give them a theoretical underpinning. Indeed the rhetoric of work on the subject of service design is often reflecting on the role of the designer in such settings and the problems of this way of working (Meroni & Sangiorgi 2011, Schneider & Stickdorn, 2012).

What can be retained from this is that, with the emergence of new Design paradigms such as Service Design, the realisation that Systems Thinking approaches are probably a natural way forward for present-day Design Praxis, has surfaced more robustly. This is basically because of the inherent complexity and the widening of the spectrum of problem situations that design teams are increasingly being called upon to help with.

In the attempt to offer an initial architecture of a Systems Thinking approach to tackling Design Problems, the primary step is to justify the claimed importance of 'how' its Design Problem Space is discovered, understood and formed. In other words 'how' to acquire a Systemic representation of that space, i.e. 'The System' with which we design.

Principles and tenets (notions) of Systems Thinking such as *Emerging Properties, Requisite Variety, Self-Reference, Organisation, Self Organisation, Distinction, etc.*, can guide the understanding and discovery of a representative System of the design problem space, primarily in terms of its parts (components) and their inter-relations. Notions such as *structure, states, control, attractors, code, etc.,* support the forming of the system of the problem space, mainly in terms of its dynamic characteristics and processes. The main aim being to acquire as representative a system as possible, with its parts and their relations and its 'life'.

Why should designers need to do this? In an attempt to illustrate the fundamental importance of creating a system representative of the design problem space, we give an anti-example, explaining what we typically see in an educational context when students presently work in an open-ended way.

A typical example

We narrate the case of an excellent student, with very good communication skills, and deeply passionate about design, who began work on his final year project with great enthusiasm. He undertook nearly two years of intensive research, in a variety of contexts and countries, and under the guidance of several supervisors. He was determined not to constrain his problem space, and gathered a mass of material making use of very many types of participative design methods and techniques (e.g. cultural probes, diaries, focus groups, semi-structured interviews, technological prototypes) as well as ethnographic approaches (observation, video ethnography and contextual design approaches).

He learnt many things arbitrarily, but in the end, he was unable to organise the material and use findings to help him to understand where to create the design intervention. Since, as part of the final thesis brief, he needed to do this, he did create and evaluate a technologically based intervention loosely connected to his problem space. This problem space was

motivating the population to take more exercise. His eventual design intervention was a mobile phone application to help users to understand how much exercise they took in a day. It was apparent that here was a large disconnect between his final concept and his research. The student himself was dissatisfied with this, and felt that there were more important conclusions to be drawn from the information he had collected, but he felt he lacked not analytic tools, but a perspective from which to view the problem space.

He had studied populations of various ages and backgrounds, in more than one country and culture in an attempt to find a generalisable intervention that could be globalised. He collected data that verified findings such as:

- people are not motivated enough to exercise regularly
- fear is not a good motivator
- difficulties to fit exercise into existing way of life
- exercise can be prohibitive
    - requiring money (equipment, gym fees)
    - requiring time (lost from work or personal relaxation time, time with family, etc.)
- exercise is 'pain for no visible gain'
- …

Some of these findings, although they arose from his data, were not particularly interesting in terms of insights, and when distilled down were not 'worth' two years of fact finding. As one of his external examiners told him bluntly "I think any popular magazine on diet and exercise would have given me the same information." The student, despite himself, had to agree.

Putting this data gathering experience in a broader perspective, we can see from research that many designers have evolved their own methods for tackling problems using, broadly speaking, the following activities. Typically we see:

- brainstorming and collaborative methods, including working with stakeholders with knowledge and experience of the problem area
- exploiting existing research results, in the tradition of quasi-subject matter (Buchanan, 1992)
- market research to see what already exists and how well these existing solutions deal with the problem

As designers become experienced, they are quicker to pick up on insights and also find it easier to gain inspiration and guidance as to where to make effective design interventions. However this takes experience and student designers and designers in training require more explicit methods.

A common practice is for the findings from information-gathering to take the form of 'guidelines' in the sense of statements that are used to guide the design of their concept. Some of these become 'staple' over time: i.e. 'the design intervention must be usable by and useful to its intended audience', although other guidelines tend to be drawn more directly from findings. In this case, it resulted in guidelines as in the figure below.

Concept Guidelines

The Design Intervention must:

1. motivate people to exercise regularly
2. avoid making people afraid of the consequences of not exercising regularly
3. ensure exercise fits into existing way of life
4. be inexpensive
5. take a minimum of time
6. make clear to the user the advantages of exercising regularly
7. must be useable by and useful to its intended audience

Figure 1

Such findings, in the form of guidelines, may act as a checklist for designers, to make sure that their concepts take into account these factors, and balance them in various trade-offs, but they do not, as such, offer insights or inspiration. Nor do they help the designer to see the bigger picture. Our student, did manage to account for 3, 4, 5, of the above list, but was not able to incorporate 1, 2 and 6, or convincingly accomplish 7. As he himself concluded, the 'big challenges' remained.

Design students are taught a variety of different methods and processes. Both designers and design students are also taught to make a 'selection of tools'. The selection used to frame and understand the design problem space often depends upon what seems the most tractable in the given circumstances. Often such spaces are framed against background of experiential knowledge (of those stakeholders, including the designer). They engage with the problem within a dominant narrative, for instance that of cost benefit, or usability, or sustainability, etc. and according to a pre-given 'brief': such as a healthier population, equality of resources, etc.

What this means is that already a reductionism is taking place, where the designer is being guided to consider some outcomes as having greater priority than others. What this can mean is solving just part of the problem. In some cases, such an approach may even create bigger problems to be solved in the future.

Towards a Generic Design Methodology based on Systems Thinking

Changing the dominant narratives which represent the Design Thinking that leads to the structuring of a design brief, is a first challenge for designers and design educators. Justifying the use of Systems Thinking for Design Thinking, is also a real challenge for those designers. In other words promoting the systemic perspective to capture and usefully describe the design space before anything else requires some convincing grounding. We cannot ignore the legacy of many techniques, tools and methods that have been tried and tested in design.

Simply claiming that human centric problem spaces are indeed complex and that complexity is usefully unavoidable, and that co-design is the norm is not enough to establish a new school

of thought for design praxis. Changing people's way of thinking from mechanistic to interconnected and from the reductionist to holistic is a very good start but most of the time it proves to be difficult for various reasons, such time and money , but as well, the relative newness of interdisciplinary training. However, even understanding that tweaking on part of the system produces effects elsewhere provides a strong argument that is close to real-life This can sometimes 'kick start' designers' thinking and nurture a positive attitude towards the holistic approach of Systems Thinking.

What remains is to provide convincing tools of thought such as methodologies that accommodate and utilise the notion of 'Holon' in Design Thinking. This is proving again and again difficult, a fact which must be investigated and dealt with. Work such as that by Ryan (2014) and Sevaldson (2011) are very convincing in their practical approach, while in addition, along with Jones (2014) and Nelson & Stolterman (2012) they offer background theoretical argumentation required to smooth the understanding of how to use Systems Thinking in Design

Despite these challenges of education and training, in Design we see a renewed and increasing acknowledgement of the need for, if not yet the deep and committed involvement of, Systems Thinking. This is fuelled by the new context of emerging design problems with their human centric induced complexity that push to the fore the need for more powerful approaches to deal with complexity.

Systems Thinking actually helps to design the design approach in a very rich and fruitful way. It primarily allows for genuine co-design and understanding of the design problem space. But apart from the holistic view of design problems and the realisation that as much as possible of the whole of the design space should be considered from the initial stages, there should be:

- systemic proposals as far as Design praxis is concerned in terms of methods and methodologies.
- acknowledgement in Design Thinking of the use of Systems tenets and potential principles in general
- also grounding and justifying with the aid of Systems Thinking the adoption of the various methods and methodologies used in Design

These proposals offer a main platform/framework to design students and practitioners for reference and grounding. We posit Systems Thinking as contributing towards both a theoretical framework for Design Culture and a methodology for Design Practice

As mentioned above, the capturing and forming of 'the system', i.e. the design problem space as a system is the core of the proposal presented in this paper. The following lines offer a first suggestion of how that system can be captured and formed using existing design methodologies, and how the tenets of Systems Thinking can enhance these methodologies to tackle the design problem and lead to possible design brief to carry on to designing the services and/or the products

There are numerous tools, techniques and methods and many collections of them (Cross, 2008; Dubberly (n.d.); Kumar, 2012; van Patter & Pastor, n.d.) as well as many methodologies and approaches used in Design praxis, some borrowed from complex human centric domains such as management. They range from those fit to contribute to capturing and understanding of the design space, and those which are used mostly to aid the process towards formulating a design brief and the tackling of the design problem. Naturally most of these, used often in combinations, are deployed for the whole of the design process. What is proposed here, as already mentioned, is to aim to acquire the System of the problem space, using already available and known tools, which are conceived to capture and form the problem space, and which can support systemic thinking.

The understanding and discovery of a representative System of the design problem space can be guided by tenets and potential principles of Systems Thinking such as emerging properties, *requisite variety, self reference, organisation, self organisation, distinction, closed (*as far their organisation*), open* (as far as energy and matter), etc. Acknowledging that any system is always dynamically evolving, the existing range of tools, etc. and methodologies can then be used to provide a form of the System that aids the utilisation of these characteristics leading potentially to the required brief. The forming of the System of the problem space, mainly in terms of its dynamic characteristics and processes can be supported by notions such as *structure, states, control, attractors, code*, etc.

In other words, the learning about, understanding of, and guidance towards a structure and form of the problem space (i.e. the System) can be accomplished by applying tools and methods such as: rich pictures; ethnographic approaches; participative design activities (ANT, Action research, co-design, etc.) and methodologies such as SSM, SDD, Giga-mapping, etc.). The proposed generic approach to design is an attempt to bring together Systems Thinking with current co-design participatory methodologies

The primary aim of this approach is to acquire as representative a System as possible, with its parts and their interrelations, in short its ‘life’. The benefits of this is that the vital characteristics of the design problem are retained and as already noted (Darzentas & Darzentas, 2014) with regard to complexity, the more complex a system appears to be, the ‘healthier’ it is, because if understood, it offers more opportunities for design interventions than a less complex one. Variety can be seen in a similar way: in cybernetics it has been 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. This means that designers will be able to add to their methods the determining of the variety of demands, i.e. the number of different demands on their design intervention. Cybernetics also provides the notion of requisite variety (i.e. the minimum number of choices needed to resolve uncertainty).

Summary and Conclusions

This paper argues for a general proposal for the Systemic tackling of design problems. The principal assumption is that the capturing and forming of the design Space of the human-

centric complex design problems should be a main design concern and that a natural way of achieving this is through Systems Thinking.

For a Systems Thinking approach to tackling design problems, we concentrate on **'**how' its design problem space is discovered, understood and 'formed'. In other words 'how' to acquire a Systemic representation of that space, i.e. 'The System' with which we design. The main suggestion here is that a 'holon' of the design problem space can be captured and formed and guide the design praxis by using many of the available design and systemic tools techniques, methods, methodologies and approaches. The tackling should be guided by the systems thinking tenets.

In the case of the student, we believe he could have benefitted from this approach. Had he 'anchored' his problem space in a systems perspective (i.e. faced the design space as a system), he would then have been able to make use of principles and tenets from the systemic perspective to help him to:

- make (better) sense of his data collections e.g. he would have discovered interconnections (emerging properties, new components…)
- organise the data gathered via various methods and techniques e.g. by distinguishing the 'relevant sub systems'

This would then have offered him support to be guided to think about ways to deal with the problem space and where the design intervention(s) could have impact. In this way he could have avoided the disconnect between elicited material and design outcome while retaining opportunities for creativity and innovation.

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