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Systems Oriented Design: The emergence and development of a designerly approach to address complexity

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Abstract: *Designers are especially well suited to cope with the complexity of the real world because of three reasons: they are trained to synthesise solutions from complex and fuzzy material and they are good at visualising which is an enormous advantage for thinking in complexity. Finally they are creative people trained to come up with new solutions. There already exists design practices geared towards dealing with complexity. But such practices need to be systematized and developed further. One way of doing this is to develop its relation to other practices of complexity found in systems thinking and systems practices. This paper reports on the development of Systems Oriented Design, an approach to learn how to better cope with very complex issues as designers. The approach is influenced and inspired by modern systems thinking and systems practice and inspired by generative diagramming. Design practice, systems thinking, systems practice, design thinking, information visualisation, diagramming, GIGA-mapping, research by design, research through design, design for complexity, sustainability.*

Keywords*: Design practice, systems thinking, systems practice, design thinking, information visualisation, diagramming, GIGA-mapping, research by design, research through design, design for complexity, sustainability.*

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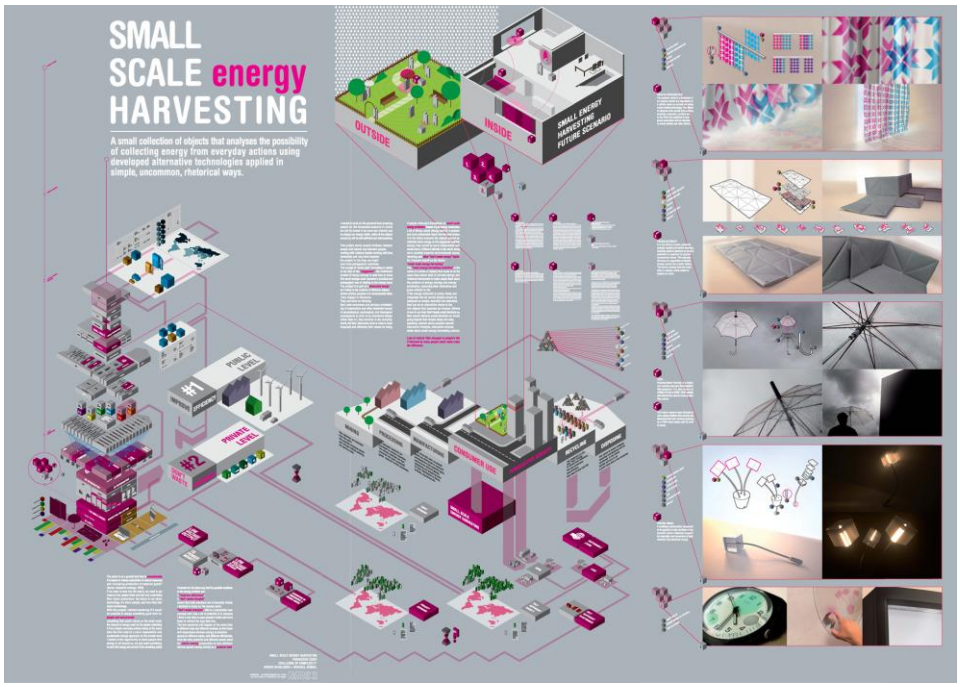

Figure 1. *The Small Scale Energy Harvesting project demonstrates a feasible way of making small everyday objects into energy harvesting rather than energy consuming items. A suggestion for super distribution of energy production. Energy is saved according to a piggy bank metaphor. (Master student Francesco Zorzi, tutor: author)*

Introduction

The practice of designers is forced into a process of change because of the increasing need for sustainable development and the increasing degree of globalization. Systems Oriented Design addresses these problems and intends to develop a better systems practice for designers to cope with these challenges. SOD is a skill based approach that is based on designerly skills. Designers are generally good at dealing with fuzzy and wicked problems (Rittel & Webber, 1973). This is recognized in different ways by people in other fields (Boland & Collopy, 2004; Brown, 2008; Maier & Rechtin, 2000; Martin, 2009; Rechtin, 1999). Within design we treat this ability as a tacit skill mostly taught in project based education and there are few if any efforts to improve these skills through targeted training and development of suited design techniques. The project based education is in some cases supplemented with different approaches to complexity that are taken from other fields, such as systems approaches or management tools. But such tools imported from other fields are not easily adapted to a designerly process. What we lack is an integration of these foreign approaches into design and a better training of designer skills to improve the inherent skills we already possess when it comes to dealing with difficult and complex problems.

SOD intends to develop such a designerly approach where certain external perspectives and theories are adapted and where inherent skills are better trained. SOD looks at modern systems thinking which deals with the dynamic complexity of real world problems in a pragmatic way. These perspectives are re-interpreted in the context of design, combining them with concepts of designing for complexity coming from within design and architecture. Further on these perspectives are combined with design thinking, reflection in action and with designing. New design proprietary perspectives and techniques are developed. These different components in SOD are merged through design practice. This basic platform is taught to design students at different levels in an un-dogmatic and open manner. The design students ideally will be capable of using the SOD approach, merge it with other approaches and change it and adapt it to individual preferences and to new emerging needs.

SOD regards designing the design process for each project as the central strategy when dealing with very complex issues.

Traditionally designers tend to focus on the result, the object. Though it might be true that designers inherently have the ability to synthesise good solutions from very complex input, this object orientation is a disadvantage for designers. Complexity grows out of the interrelations of objects and hence we need to pay attention to the system level. New trends in design, like software design and service design, have changed the attention from object focus to systemic interventions, experiences, interactions and development over time through versioning. This development points towards a more complex design process that might have elements of systems thinking. But the scope of these projects is still limited. The framing of the projects in these cases tends to be set by commercial interests only or conventions or directed by “best practices”, instead of through active inquiry and mapping of many imaginable relations and of some of the possible consequences of specific design interventions. Such deep engagement in the systemic interrelations is needed to reach solutions that combine ethical issues with sustainability, economy, new technology, social and cultural and commercial considerations etc.

Systems Oriented Design is un-dogmatic and design oriented in its approach to systems. The systems oriented designer is initially less concerned about hierarchies and boundaries of systems and more interested in looking at vast fields of relations and patterns of interactions. She is geared towards looking at as many interrelations as possible and working with a “field-feel” and holistic overview, while making details accessible. The systems oriented designer is looking beyond the object (product or service) and she perceives the object merely as a “symptom” or “outcropping” of vast systems that lay behind the object (Figure 2).

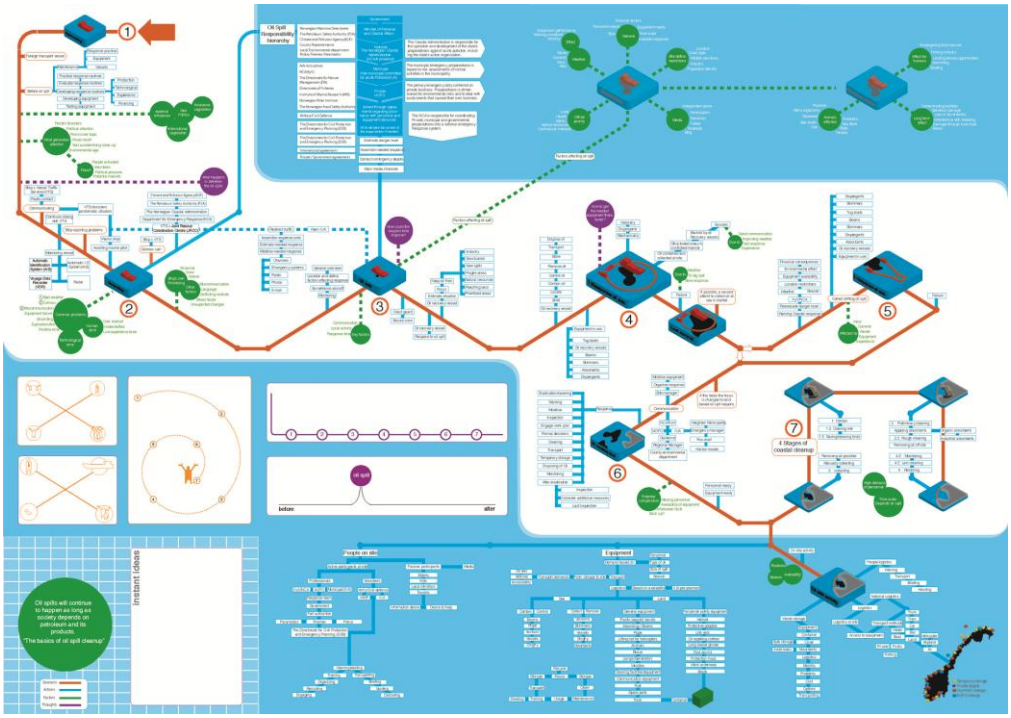

Figure 2. *The diagram shows the flow of actions during an oil spill accident when a ship runs on ground outside the cost of Norway. It shows all the actors and stakeholders involved and influenced by such an event. But moreover it also displays potential for new systems interventions. The result was an innovative way of interconnecting all actors, official and private in a social network that communicates risk factors and risk awareness, so that preparations can be made to prevent such accidents of happening. (Master thesis by Adrian Paulsen, Advisor: Birger Sevaldson)*

The systems oriented designer is both humble and bold. She is not scared by the complexity of a task but she rather embraces this complexity for the inherent potential for innovation. She is also not afraid to enter new fields for design, unknown to her. At the same time she is humble towards the need for knowledge and the need to learn very fast when entering such new fields. She relies on building up expert networks to compensate for lack of knowledge.

For each design case the phenomena at hand is deeply researched, starting with a very rapid learning process with a very steep learning curve. This process starts with visualisation: large maps are used for systematizing and interrelating the knowledge, preconceptions or speculations we already have of the subject. This needs to be done to an extent that produces several hundreds of items on the maps (Figure 3). Hence these are called GIGA-maps. The maps are reinterpreted and fleshed out together with stakeholders or new sets of maps are drawn together with them.

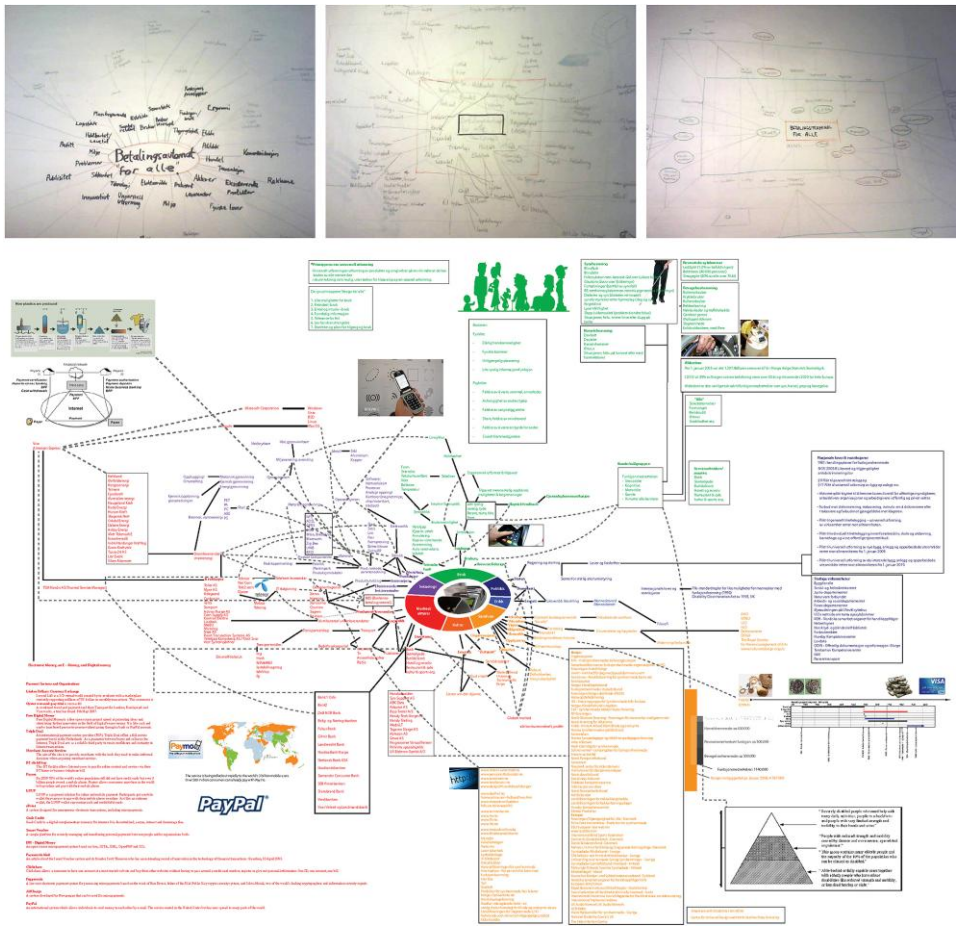

Figure 3. *A project for a new payment terminal developed into a system for consumer empowerment through deep systems understanding of the processes of shopping at super markets. Needed information about relevant issues was provided at the buying moment to the consumers so that they would be able to make informed decisions. (Master Student: Erik Lindberg, tutor: Birger Sevaldson)*

Blank spots are zoomed in for further research, the needs for expert networks are defined, and points for potential interventions are found. For each case the visualization methods vary. The approach resists too early and poorly founded simplifications. Where others tend to ask for simplifications in Systems Oriented Design we ask for richness. The models are built from the dialogue and research rather than built upon existing systems dogmas.

The systems oriented designer is a good designer (unlike many of the other approaches e.g. organisation design or education design, using the term design but where the value of design skills is disregarded). She uses designing as a way of thinking through, ordering and internalizing a picture of the information cloud needed to reach a resolution of the issue at hand and to induce a creative process. But she also resists the

urge to over-design the maps. She keeps the design of the mapping open because she knows that it will always be incomplete.

The GIGA maps are used for drawing the boundaries and framing of the system and for generative processes. Only when one has mapped far beyond what seems relevant one can draw boundaries in a meaningful and informed way. Boundaries and frames are adjusted and redrawn when needed. New ways of diagramming might be invented and adapted to each case. The diagrams are developed through stages of redesign and refinement and ultimately used for reaching creative solutions and innovative interventions. Intuition and a holistic view and operating on many scales and zoom levels simultaneously, breaking schemata and looking behind typologies and clichés are all parts of these processes.

The research of SOD

The research on SOD is based on Research by Design methods discussed earlier in depth by the author (2010, 2000) and by various other authors. (Binder & Brandt, 2008; Dorst, 2008; Dunin-Woyseth, 2009; Fallmann, 2007; Koskinen, Binder, & Redström, 2008; Mattelmäki & Mathews, 2009; Niedderer & Imani, 2008)

The research reported has been conducted over the last years by the author and colleagues at the Oslo School of Architecture and Design and has been reported on in 2008, 2008, 2009, 2010 and 2010 and also earlier publications. It has been focussed on design student education and developed most of all as a way of teaching students to get better at coping with complexity. The research is under development and has at the moment moved into bigger financed research projects in collaboration with larger companies.

The theme and concepts of SOD have been developed within a teaching based research position. This is based on and located in a pedagogy of inquiry. This means that each student project has a potential for discovery and the creation of new knowledge and concepts. The student projects are not following given tracks; in contrary some of them are entering new fields of design. When students do this the studio and project based education reaches far beyond a master apprentice relationship or the simulation of a professional design project. Such projects quite often work in ways that professionals cannot operate in. The project becomes a real research by design project and takes a special role and mode of inquiry and reflection that only can be found in research oriented design schools. Much of the detailed experiences that are generalized in the Rules of Thumbs the types of relations and ZIP analyzes has emerged in that context through reflection upon students work and through dialogue with them.
Such a project that exemplifies these modes is shown in the following section.

Design for dignity in a sexual violence response system

This project is the master thesis of students Manuela Aguirre Ulluoa and Jan Kristian Strømsnes, 2012. The project was done in collaboration with the Sexual Assault Centre (SAC) at the Legevakten emergency hospital in Oslo. Starting this new collaboration with a field and people who have not previously considered the expanded role of

design was not an easy task. It was like opening a new field for design and together with the staff from SAC investigate how design can contribute in this case. The project addresses many aspects of SAC, spanning from information to products and interior as well as processes.

Figure 4. *GIGA-map showing the whole landscape of sexual assault. The prevention field to the left and the response filed to the right. The image shows the final map after it was developed through many iterations and developed to the final design artefact shown here. Designing the map is an important reflexive thinking-through-designing process that makes it possible to organise and internalise large amounts of information and to crystallise and design its relations.*

System Oriented Design gave them the right tools to get an overview of the whole landscape of sexual violence. The GIGA-map was based on research into qualitative and quantitative information and on expert knowledge (Figure 4). The research needed to be very extensive. They were entering a field where they knew very little and it was crucial to understand the systems properly to be able to suggest adequate design solutions. Through many iterating and quality checking the information with the experts, the GIGA-map was made as precise as possible. The map also became a tool for the staff at SAC and the collaborating special police unit. It created an overview of their own work and services and how the whole system operated. This helped the staff to coordinate their perspectives. Further mapping in collaboration with expert employees unfolded the processes that victims had to go through at SAC (Figure5). This initiated a user-centric perspective creating a base for the design process.

System Oriented Design helped the students to gain control of and systematise all of their ideas throughout the design process. The ideas emerged out of the context and the knowledge they gained and out of collaboration with experts. All ideas were documented in relation to the context (Figure 6).

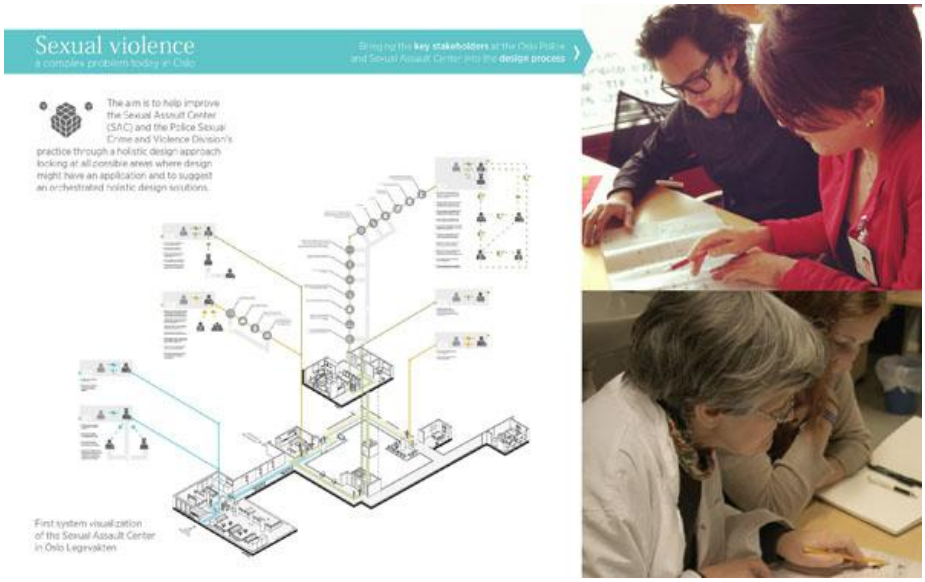

Figure 5. *The map of the user journey to the left was constructed and co-designed with the staff from the police and SAC. While the intention for this mapping was for the students to learn in detail how the system works, it turned out to become a product of its own immediately adopted by the staff for their purpose*

Figure 6. *Information system (left) and Safety Blanket with built in pockets to prevent contamination of evidence on the victims hands (right)*

The students reported on the following benefits from GIGA-mapping
- Sharing overview: People will synchronize the same overview
- Understandable, easy to point out and find opportunities for stakeholders and the designers
- Creates a common and understandable setting for dialogue and opportunities where new solution can be placed in the existing system resulting in stepwise improvement of the system.
- The GIGA-map can be used in a training program for staff members, teaching a common synchronized overview of the response system.
- Visualization in GIGA-mapping creates shared images between the designers.

While developing the GIGA-map partly in collaboration with the staff they realized that this overview became a product for the stakeholders. It was then redesigned with the purpose to be used by the staff, helping them to get a better overview of their own system.

The final proposal contained several choreographed and synergetic systems interventions spanning from small scale products to interior scale and information system (Figure 6 and 7).

Figure 7. *Suggestions for spatial organisation and design for a new SAC. The design seeks to balance between the clinical, the comforting and a calming and neutral atmosphere. The design of the interior and information systems are synchronized.*

The development of SOD

SOD is not only inspired by systems thinking but also from experimental architectural design in the nineties and early 2000. The outputs of these experiments are popularly known as blob architecture and folding in architecture. Animated processes and diagrams played a central role. (Bettum & Hensel, 2000; Deleuze, 1993; Eisenman, 1993; Kipnis, 1993; Lynn, 1993, 1995, 1998)
The author was working in the field of experimental digital architecture and design, using digital tools to question what the design process was, what it could be and what the role of a new type of open ended design could be (Sevaldson, 2005).
Using computers with e.g. animation software or programming algorithms generated new visions of design. The design process was partly and in periods taken over by the machine, though the designer maintained an influential decision -making role and applied aesthetic judgement in the development of the design. He anticipated to be surprised by the outputs of the machine. He created a framework and setup that had controlling devices but the running of the device generated to a certain degree unexpected results. By tweaking the many parameters involved and run it again and again continuously new and differing results would occur. This prepared the basis for new interpretations of the concepts of open design and versioning. The conception of a design output as ideal and with only one good solution was left and replaced with the idea that a design output could have many variations and forms. These forms could change over time. There was a notion of the unfinished as a way to involve users to inhabit designs with their own agenda. The user participation endured throughout the lifetime of the product, changing it according to emergent patterns and user needs. The designs were regarded as open dynamic organisms rather than static products.

These principles are now quite common in an increasing number of design fields. This is obvious in the field of software design through versioning and in the emergence of social networks where user generated content has the defining power, these principles made their ways into IT business and became central aspects of any successful strategy.

In this landscape it became more obvious that developing methods for designing for the unexpected, for change and for and with time was essential. The author experimented in design education within these fields. The design studio with advanced design students became a laboratory for developing new concepts. First there was a series of workshops investigating the use of software in experimental design, recognizing that the digital realm changed the conditions for design. These workshops were followed by several design studios investigating time as a design material, similar to other design materials like clay or computer code (Sevaldson, 2004). Time was explored in terms of composition similar to what a film-maker or music composer would do. This composition principle was easily transferred to the idea of the open design and from there to interaction design and service design. The other aspect that was investigated was using time-based approaches as analysing devices. Sequences of everyday activities were looked at in a very distanced and rigorous way. This could be observing a central public place in Oslo, observing the life at a café or observing oneself when cooking dinner.

These observations that did not have any intention of design output became design objects themselves. It emerged an effect of rediscovery and an eye-opening effect that

created a foundation for creativity. It was especially obvious how these observations broke down prejudices and schemata. Seemingly simple everyday actions, like cooking, were rediscovered as enormously complex. It demonstrated that we don't only have schemata about things but also about processes. The process of cooking dinner is such a process schemata, simplified to something iconic or an archetype of the process that we have stopped reflecting about. The schemata stand between us and the pure unfiltered observation. Observation became a method of breaking schemata and arriving at innovations.

The sequential analyses and observations in the Designing Time studios also made causal relations emerge and at a moment it became clear that we had migrated into the field of systems thinking.
Systems thinking was a vast field to dive into. Approaching it from the design process and with the special story and a clear idea of what kind of practice we wanted to develop it also became clear very soon that the current theories, models and approaches in systems thinking were insufficient for design. There was a need to maintain the ways we worked and to enrich it with systems theories and approaches. E.g. hard systems models like casual loop diagrams where difficult to apply. Not everything can be squeezed into a cause effect model. When applying the fixed traditional systems models to design situations that reach beyond the purely descriptive and that are about generating something new, the models became moulds rather than analysing devices into which real life innovation and reshaping needed to be framed. The models tend to dominate the conception of the world. For design such reductive systems models where not very helpful except as a sub-analyses in a much larger process of information-rich and media-rich modelling.
On the soft side of systems thinking there we found more useful approaches end e.g. the so-called Rich Picture from Soft Systems Methodology. The Rich Picture is a diagram that is drawn to generate an holistic overview of a situation (Checkland, 2000; Checkland P. & Poulter, 2006). This was more close to what we needed. The view from SSM that systems not necessarily are given in nature but that they are mental models was useful though the author does not entirely commit to this relativist stance. But it opened up an approach that was more flexible to generative mapping. Still the concept of the Rich Picture was lacking some central features. It was still geared towards the descriptive and did not provide a bridge towards the generative design action. Also it was not involving designing as a central approach to the mapping process.

Instead of committing to one or the other existing mapping models we started to use very extensive mapping as an approach. It also became clear very early that keeping these maps very consistent and categorically correct was also not working. In fact we needed a certain degree of messiness and juxtaposing categorically different information resulted in the discovery of hidden relations and the creation of new ones.

Free-styling, media rich mapping was developed and eventually coined GIGA-mapping by the author.

The designerly approach to mapping made me aware of the importance of designing as a way of investigation and generation of visions that opened up the space for intervention. GIGA-maps therefore developed into design artefacts. This was an important step because this realization connected designing and analyses and

reasoning into one device. Designing was used in close relation to analysing and synthesising. Also it became clear that designing the response and eventual output from the mapping very early was then connected to the research. By designing new questions emerged followed by new rounds of inquiries and mapping.

Through the discussions and tutoring with students GIGA-mapping developed into a nested design process, the design process of designing the maps. Designing the maps through stages of refinement shifting between manual and digital media also helped the designer to internalize very large amounts of information. It also became a natural part of the design space. Printing it out in hard copy and hanging it on the office or studio wall would make these large amounts of information immediately accessible at any time. The students' workspaces were altered with wooden boards to add more areas for hanging the maps and other information (figure 8). The war room reference or crime investigation wall panels were obvious (Leerberg, 2004). The concept of the Rich Design Space emerged from the testing of these principles. This was the physical space the media, the social space the internet and cultural space where the design process was playing out. The author argued that such spaces should be "gardened" to be rich
The GIGA-map acts as a bridge between inquiry and design.

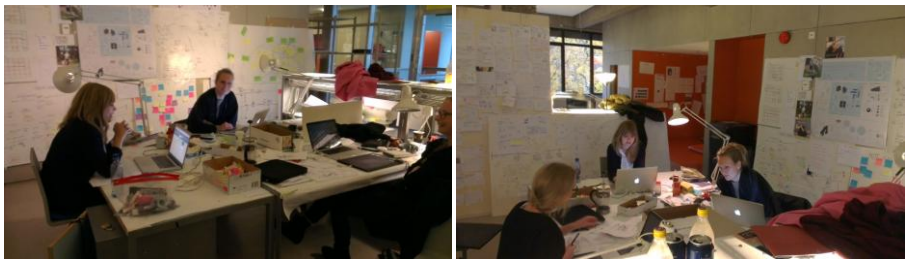

Figure 8. *The Rich Design Space: A studio space with students working with defining design interventions in an elderly home on three systemic levels. They are immersed in their information gathered from different inquiries workshops, experts and collaborations.*

While investigating the design development of the maps into ever more refined versions another pitfall became obvious, the over-designing of the maps. Designers have an urge to order and sort and compose their designs. When we started to look at the GIGA-maps as design artefacts a tendency to over-design and order the maps appeared. This has a similar unfortunate effect as the static old systems models, the map would start functioning as a mould rather than as a generative open ended tool. Therefore keeping the maps at an open level, not over designing them is important.

Current stage

Today we are at a stage where the techniques of SOD are about to be refined and lifted to a new level. We need on one hand to frame the techniques better so to develop a clearer methodology for SOD. But this has to be balanced. We don't really want to develop yet another method but a flexible tool kit for designing for very complex situations. System thinking is in our context a mind-set and a skill. By framing it to tight we run the risk of losing flexibility and innovation in the process itself. Instead of being a responsive systems thinker one risks of following yet another rule set, stopping with designing the design process and instead relating too much on patterns and repetitions.

Techniques and approaches to SOD

The systems oriented mind-set

The first problem one meets when working with super complexity is to switch mind. Complexity comes from the relations and not the entities themselves. Objects are relatively easily understood if they are not too complicated, that is composed of numerous components that interact. Then we are actually looking at an entity that reaches beyond the singular object, we are looking at an entity that is a system.
It is the relation and interaction that makes it difficult, otherwise we could just dismantle the system and look at the singular objects to understand the whole. It would be a tedious but simple job. The mind-switch needs to be in shifting attention from the objects and entities to the relations between them. This is the simplest way of explaining how to become systems oriented in your thinking and approach. But it is also one of the biggest challenges to teach to design students. There are big individual variations to how easily they adapt systems thinking.

To understand what systems thinking is we can turn to some central examples that everybody relates to. One such example is the concept of ecology. Ecology is an interdisciplinary science, about the interplay between numerous species and their environment. The science of ecology can't be reduced to singular fragments nor can it be sufficiently investigated through isolated lab experiments. Very advanced simulations and systems dynamic modelling can simulate parts of ecological interplay but renders only partial understanding of the problematiques, leaving a high risk of errors. Further on ecology is an interdisciplinary science, cutting across many of the natural sciences. Modern ecological thinking does not separate human activity from the natural but looks at the whole interaction of man with nature. Therefore ecology also touches upon economic, technological and even sociological issues.

Looking at businesses, organisations, advanced design interventions and even seemingly simple design projects in a similar manner, regarding organisation, businesses and operations as "organisms" living in "ecologies" is really helpful to change the mind set towards systems thinking. Designing involves technology,

ergonomics, interaction, marketing, branding, competition, culture etc. Designers know that they need to relate to all these issues, but often react to them as necessities rather than source for creativity and innovation or they think of the as specialization fields rather as parameters necessary to address. Many designers are searching simplification to reach solutions. As a systems thinker one would proactively search for and increase this complexity because of an urge to understand it better and because one thinks that in the complex interplay between all the fields, knowledges and requirements that confront a design project one will find new approaches and solutions. This richness is conceived as a ground for creativity. A systems oriented designer would inter-relate these fields better and even increase the complexity by adding considerations about the client's organisation, culture, capacity, economy and global considerations on sustainability and fair trade etc. Further on one would be concerned about the life time of the product, the implementation process, the marketing, what the product would replace, how it would develop through versioning, and about recycling and sustainability. The systems oriented designer would also be interested in the secondary and tertiary impacts of the product. Also the unintended and counter-intuitive consequences of chosen design interventions would be necessary to foresee. She would also be interested in how the design intervention would act as a system in its own right. Would it survive unexpected disasters, so-called "Black Swans"? All these issues are not novel by themselves but they are typically addressed only partially by designers and many of them are addressed only by separate experts, technicians, economists, sociologists, in isolation. The systems oriented designer would try to achieve a holistic perspective to oversee the consequences and to find intelligent design outputs. In fact one would start to look at the product as a systems intervention, realizing that the product is merely a symptom of a large system.

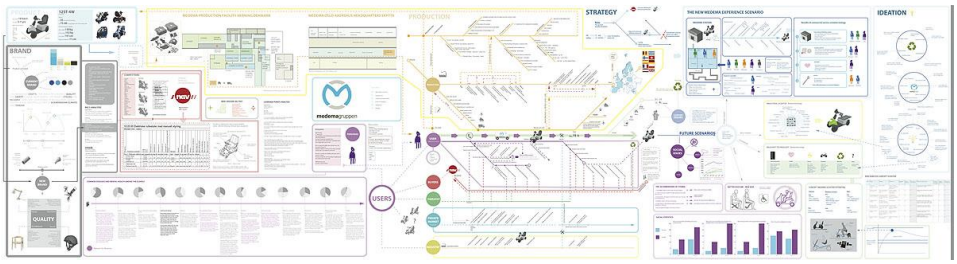

Figure 9. *The final GIGA-map for MEDEMA. The map shows all aspects of the company operation from production facilities to economic and marketing aspects. The map is displayed in the board room of MEDEMA. (Christian von Hanno and Julian Guriby).*

GIGA-mapping

As mentioned earlier GIGA-maps are very large and information-dense diagrams and visualizations (figure 9). Their purpose is to support the design process. They are developed from sketch to final design through using different manual and digital drawing tools and develop them through iterations. They are not meant for information visualisation where communication and simplification is central. In fact in many cases they are so complex that one has to be involved in their creation and design to "own" them and understand them. They help to keep track of systemic relations, information

and to internalize as much as possible. They are moving far beyond the descriptive towards generative modes designing interrelations and new structures. This is becoming a design process in its own right where design thinking and designing is used as central approach to reconfiguring and generating new information. Therefore we regard them as design artefacts

The central way of keeping track of the complexity that unfolds when shifting mind from being object oriented to being systems oriented is, for designers, to use design. We use our design skills as a way to create an overview and to generate a picture of the whole.
I use the terms create and generate consciously because as systems oriented designers we go quickly beyond the purely descriptive. We want to go beyond "what is" and towards "what ought to be". By using the designers skills in the process of understanding and designing for complexity we realize three things:

1. We realize the strength and potential of designing as a way of sorting, ordering, and visualizing complexity.
2. We also realize that any model, diagram, visualization of real world complexity is a mental construct or a design. It always fails to remain purely descriptive but the models and techniques frame the interpretation of real life and take on a generative role. This role can be strong or weak but there is always a generative aspect in the diagrams.
3. Designing and developing these generative interpretations consciously and using design to develop them beyond "what is" towards "what ought to be" is an efficient approach to design for complexity.

The term GIGA-mapping engulfs all these processes of using visualization in design processes to understand and develop complex systems.

There is one important issue to remember: It does not embrace the common approach to complexity that urges for simplification. Simplification is needed sooner or later in the design process but before we understand more of the system simplification done without that knowledge is dangerous. It can lead to totally wrong conclusions and assumptions. To early simplification is regarded as a lack of real attempts to read, wrestle and interact with the immense richness and systemic entanglements that surround us. These will not disappear by being ignored. The task of GIGA-mapping is not to simplify. In contrary it is to explode the systems to get at the hidden relations and connections, to reach beyond the simplified schemata that are embedded in our typologies and archetypes.

Simplification and boundary critique

Only when we know enough of the whole picture we can draw a systems boundary (simplify) that is relevant. A critical approach to the boundary and looking at the boundary of the system as adjustable is important. This approach is theoretically rooted in boundary critique (Ulrich, 2002).

Mapping process

The mapping typically starts messy with paper as the main medium. This is like any other design process, starting with messy tentative design sketches. Large formats are necessary. Small formats and working on the computer are insufficient simply because of lack of resolution. A simple rule of thumb is that we need a minimum of 300 entities and their interrelations on the systems sketch.

SKETCHING

The mapping often starts in one of two ways: network mapping or timeline mapping. The main issue is to very early to have great attention to the relations. Sketching should start immediately without prior inquiries into literature or other sources. The initial sketching is meant to activate already existing knowledge and imaginations about the issue at hand. After this initial round we start doing literature research, talk to experts, search for projects etc.

It might seem that the immediate sketching could impose a preconception onto the problem, but in fact the intention for this is the opposite. The sketching out discussing and reconfiguring of one's prior knowledge is not only to activate this knowledge and make it explicit, but also to raise consciousness of the inherited frameworks that we tend to take for given and that if not challenged would bias the information gathering.

After the initial sketching phase the maps are developed through information gathering. The map indicates areas where one needs more information and experts one needs to talk to. The map works as a guiding device for the research, while the research feeds back into the map and develops it further.

Very early in the process we need to start the design process by several activities

1) Starting to create relations on the map moving form a descriptive mode to a generative mode.
2) Imagining and sketching solutions and design outputs
3) Deriving new questions from design outputs to the map

The map in itself does not generate design output. For that we need a synthesising process that starts early and runs parallel and in dialogue with the mapping process. At any stage we use ZIP analyses to make findings in the map (described below)

CO-MAPPING

Mapping in groups has an effect on dialogue. It fosters dialogues and collaboration. Especially the short workshop types developed for strategic meetings in leader groups has a very strong impact on the dialogue.

These most often are time based maps that follow a timeline. The time line is used as a sorting device that is immediately understood by everybody. This sorting device allows the group to skip the agenda, as long as one has a theme to investigate. The conversation is allowed to jump back and forth. Jumping in the discussion is done easily because everybody is brought along in the jump by pointing to the time line. The conversation stays focussed on the topic but remains open ended and holistic.

REDESIGN AND ITERATIONS
After the initial sketching phase it is a good idea to change media and to redesigning the map in illustrator. This is when design thinking fully kicks in. The process of converting the messy handmade sketch into a well designed illustration implies a mental process of sorting and ordering. It also has the effect that the information is internalized and memorized often in an astonishing way. This might be a phase where one works alone and the holistic overview is generated. The role of keeping a holistic overview is by some described as being a feature of singular individuals or very small groups working very closely together (Maier & Rechtin, 2000)

TYPES OF RELATIONS
Another difficulty in mapping is the tendency for us to emphasise objects rather than their relations. It is important to develop the relations and to be specific about them. Therefore we have developed a guide for analysing the types of relations.
(See addendum 1)

THE USE OF MAPPING SOFTWARE
We have tested and looked into a long range of mapping software but do not recommend them for other use than for partial models embedded in the GIGA-map. They tend to be too inflexible and unappealing for designers. The software tends to become moulds for the model of reality we intend to develop.
Reference to
http://www.systemsorienteddesign.net/index.php?option=com_weblinks&view=category&id=38%3Asoftware&Itemid=48

FREE-STYLING AND RULES OF THUMBS FOR GIGA-MAPPING
There are no fixed rules for GIGA-mapping. It is not another systems model to follow but it is a generative and creative process. Therefore we emphasise GIGA-mapping as free styling where each case demands a partly genuine design process and each map will look differently and their adequacy has to be judged according to the case they serve.
Despite this we have managed to generalize some of the experience in a soft manner, resulting in a long list of Rule of Thumbs for GIGA-mapping The most important one is to mentally switch of the relevance filter in the beginning of the mapping process and not to over-design the maps so that designing becomes too much of a forming mould for the description and conception of the system.
(See addendum 2).

Analysing

ZIP analyses

ZIP-Analysis is a simple method for developing GIGA-maps and to find potential areas for interventions and innovations.
ZIP stands for Zoom, Innovation, Potential. Actually it should be ZPI because the three modes are gradually moving towards innovation but ZPI-analyses sounds strange :)

Z : Zoom is used to mark areas or points in your map that need more research. It is a reminder for you that you lack information and an initiator to make additional maps zooming into this area.

P : P stands for potential. If there is an obvious problem this is a potential for improvement or if there is something that works exceptionally fine there is a potential to learn from it.

I : I stands for innovation and / or intervention. If you find something new you can do or you find a solution to a problem or you can link things in a new way by creating new relations these are I-points.
(To see more details of ZIP analyses see Addendum 3)

Research by design, Synthesis and designing

The GIGA-map can provide ideas for innovations e.g. through the ZIP analyses, but it does not generate a design solutions by itself. It is important to not phase the process in strict sequences but to layer them and start designing and sketching in parallel and very early. The design solutions can be back checked to the GIGA-map. Only through design relevant questions will emerge and this will inform iterations of mapping and research. Then new design solutions have to be visualized and from them new knowledge realizations and questions emerge.
The GIGA-maps are research by design driven because they are design artefacts that generate novel needs for information. As well as the design sketches that are driven forward in parallel will have this functionality of research by design by clarification of problems that needs to be solved, of posing new questions to the map and by the emerging novel solutions.
Only through these design driven knowledge processes we can reach new design resolutions.

The application of the approach:

GIGA-mapping has been tested and developed in a long series of semester long studios from 2007. These include eight semester studios at AHO and one semester studio at Syracuse University School of Architecture. Another main format has been weeklong workshops. We have been running these workshops at Tallinn School of Technology, Kolding School of Design, Ålesund University College, Oslo National College of the Arts, University College of Oslo and Akershus, OCADU in Toronto. Shorter workshops have been run at Chalmers Institute of Technology institute for Architecture. Its earlier phases have been practiced and tested in numerous two hour workshop sessions with companies and organisations in a professional context. Amongst them are, the Norwegian Research Council, BUFDIR (The Norwegian Directorate for Family Youth and Children) and others.

There also further development of the mapping has been done in one case with TPG and a student and with several development projects with Gjensidige insurance and with The Norwegian Housing Bank with research assistants.

The Results

The feedback has been consistently positive. Only in one case the mapping was less successful because of the mindset of the participants.

We can separate the users into seven groups

1) Design students in SOD studios who have used GIGA-mapping in longer projects spanning over one semester
2) Design students who have participated in one-week workshops
3) Companies who have been partners in longer projects and who have done GIGA-mapping in shorter workshops with the students and who received a project result in the end of the project.
4) Companies and organizations that have a long term R&D-based relationship with SOD
5) Companies who have participated in shorter workshops in a professional consultancy setting
6) PhD candidates using systems theories and SOD as part of their research framework
7) Testimonies from colleagues in design education

(See addendum 4 for a partial and intermediate summary of feedback from some of the different groups)

The reports from the different groups have been consistently positive. There are some problems in the incompleteness off this tentative registration of feedback and it needs to be followed up with a more robust inquiry.

The technique of GIGA-mapping has developed into many different variations and we have started the work to analyse the material. Two main strands have emerged and have been developed:
The main approach is GIGA-mapping for designers to use designing as a way of dealing with complexity. These are maps that go through generations and that switch media and are refined and consulted many times through a complex design project.
The other important strand is GIGA-mapping for open ended meetings on strategic level. These are normally done with leaders in companies and organisations. They are normally non-designers. The main format is timeline mapping and there is an emphasis on dialogue and content.

For education a lot of experience is collected and resulted in two main formats: Longer project based education where SOD is the central approach. This format has proved to be very well suited for master level students to enter new fields and open up new areas for design. The approach generates creative and systemically grounded results. The students are very well equipped to develop this approach further but would ideally need additional training and instruction.

The other main format is the one-week workshop. This has turned out to be a very efficient format to teach SOD and GIGA-mapping very quickly to a level where students are able to adopt the technique themselves. They will not have a good overview of the theory and would have to get further instruction especially on the systems analyses and

understanding. But the workshop is easily embraced by the students and they adapt GIGA-mapping quickly.
Especially the last point proves that the designerly approach GIGA-mapping represents is attractive to designers.
For PhD fellows we are just in the start of investigating how to implement and use SOD approach in such longer research projects.

Another emerging result is the extraction of mapping principles from the GIGA-maps. This work has barely started and it needs to also be compared with and informed by other information visualisation work.

Summary and conclusion

Systems Oriented Design is under development and there are many imaginable techniques and approaches yet to be explored. The responses to the concept and the techniques have been very positive. Design students and some professionals have embraced the concept and especially the technique of GIGA-mapping. The flexibility and creativity in the approach has a great appeal to designers. Also GIGA-mapping with groups of professional leaders and other stakeholders has resulted in very positive feedback. The technique has been adopted by the counselling group of the Norwegian Design Council.

The bases for a larger R&D project into SOD is created and summarized in this paper. The concept as a research project is now moving into its second phase where experiences will be investigated more systematically and the concepts developed further, and emerging patterns of use and application will be mapped and reported on.

Addendum list

Addendum 1
http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=220&Itemid=136

Addendum 2
http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=214&Itemid=126

Addendum 3
http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=212&Itemid=125

Addendum 4
http://www.systemsorienteddesign.net/index.php?option=com_content&view=article&id=224&Itemid=137

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