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Integrated design and urban resilience

Designing HopeSpot: A Case Study in Applied Design Research for DRR

Strategic fields: Managing / Designing
Topics: Communities

Abstract
The need for an integrated and holistic approach to disaster risk reduction has been highlighted in recent international frameworks. The challenges posed by Large Scale Sudden Disasters (LSSD) require a comprehensive preparedness and response. Solutions to increase the resilience of urban spaces do not lie in a single area of expertise but requires interdisciplinary cooperation. This paper takes the position that the discipline of industrial design and applied design research can play a strategic role in bridging this divide.
This paper will demonstrate through a case study how the Bezalel Academy of Arts and Design's RDFD (Relevant Design for Disaster) research group uses traditional design techniques combined with a co-design process comprised of a multidisciplinary team of experts to conduct applied research.
The outcomes of the applied design research, the information of an integrated team representing a broad platform of knowledge and expertise may further common knowledge languages that encourage the creation and implementation of effective methods and tools tailored to the specific needs of communities in hazardous situations as well as during routine times.

Text / Testo

Introduction- challenges in addressing urban resilience

The challenges posed by Large Scale Sudden Disasters (LSSD) create significant tests for city residents and agencies in charge of the security. Management of urban scale disaster events involving tens or hundreds of thousands of people requires meticulous planning, building effective operating procedures and product support. This mammoth challenge requires a comprehensive response, with technologically advanced tools and experience. Solutions to increase the resilience of urban spaces do not lie in a single area of expertise as recently stressed in the *UN-Habitat III* draft new urban agenda, and requires interdisciplinary cooperation (*UN-Habitat III* draft agenda, para. 11g, 98, 140). Such preparations need to consider the before, during and after situations posed by disasters. At present, there is a gap between the knowledge developed in research (i.e. in climate change and technological developments) and its application in the field. This is seen both in disaster management (for example, in resource management, choosing shelters for victims, communications) and concrete actions on the ground including, but not limited to, adequate warnings and responses to disaster situations, the construction of temporary dwellings (such as tent cities), as well as mitigating domino threats through the design of buildings and infrastructure.

The pressing need for integrated and holistic responses in the field of disaster management has been highlighted in international forums including the *2005 Hyogo Framework for Action (*United Nations, 2008*)*, and more recently in the 2016 *UNISDR Science and Technology Conference on the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030* [1]*,* where Working Group 3 stressed the need for an interdisciplinary focus in the field of DRR:

"It is important to ask how the integration of existing knowledge through multi-disciplinary work has furthered our understanding or may do so in the future."

(UNISDR, 2016, p. 4)

Furthermore, The *UN Sustainable Development Goals* have also noted the challenge and one of their goals (11B) by 2020 is to expand the number of cities that have holistic DRR policies and plans in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015, p. 22).

This paper takes the position that the discipline of industrial design and applied design research can play a strategic role in bridging research gaps. This strategy is demonstrated through a case study that sought to enable communication and crowd management when infrastructure collapses in a major disaster. The case study was part of the Designing Safer Urban Spaces project, a 48 month FP7 security project that developed tools to assist built environment professionals and urban managers to create and maintain safer urban spaces (Bosher, 2014; Chmutina, Bosher, Coaffee, & Rowlands, 2014; Chmutina, Ganor, Bosher, 2014; Turner, Ganor, Singer & Avitan).

The HopeSpot Case Study

Industrial Design as a discipline in general, and applied research and experimental development[2] methods for design in particular, can connect between needs and technology, concept, material and shape (morphology). Design can also serve as a language that can link practitioners with urban users and vice versa, bridging gaps in defining challenges and formulating solutions. It is this encompassing ability of design practice that can serve as a viable connection between scientific research and the resilience challenges experienced by urban communities. Through the applied research and experimental development process that conceived the HopeSpot, we demonstrate a case where integrated design was used to strengthen urban resilience.

The initial question that guided the design research of the product was "*how to enable communication and crowd management when infrastructure collapses in a major disaster? "* Led by the Bezalel Academy of Arts and Design's RDfD (Relevant Design for Disaster) research group, a multidisciplinary team of experts evolved and spanned a variety of disciplines including industrial design, anthropology, disaster management, aerodynamics and urban design and planning. In this design case study, the process was a critical part of understanding the ability of applied design research to offer solutions to problems raised by the many stakeholders, first and foremost the urban users, who in this process were viewed as co-designers in the design of the product. The product's initial objective was to provide an efficient, cost-effective and accessible solution to ease communication challenges between authorities and the public.

[1] The UNISDR Science and Technology Conference on the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 "reflected on the wider scope of the Sendai Framework, which applies to the risk of small and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or man-made hazards as well as by related environmental, technological and biological hazards and risks. The Conference reiterated the need for more integration and promotion of the holistic approach to the science of hazards." (UNISDR, 2016, p. 1, http://www.preventionweb.net/files/45270_unisdrscienceandtechnologyconferenc[2].pdf)

[2] **Applied research** is original investigation undertaken to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. (OECD Frascati Manual, Sixth edition, 2012.)

Experimental Development is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products or devices, to installing new processes, systems, and services, or to improving substantially those already produced or installed. (OECD Frascati Manual, Sixth edition, 2012.)

The original artist concept envisioned a large static balloon with large dimensions that would float over the surrounding areas and serve as a type of portable beacon, creating a mark in the sky that survivors of disasters would recognize as a signal indicating aid locations. The first round of ideas included the potential use of lasers and drones, whose usage would require substantial energy as well as training and skill on the part of the team on the ground.

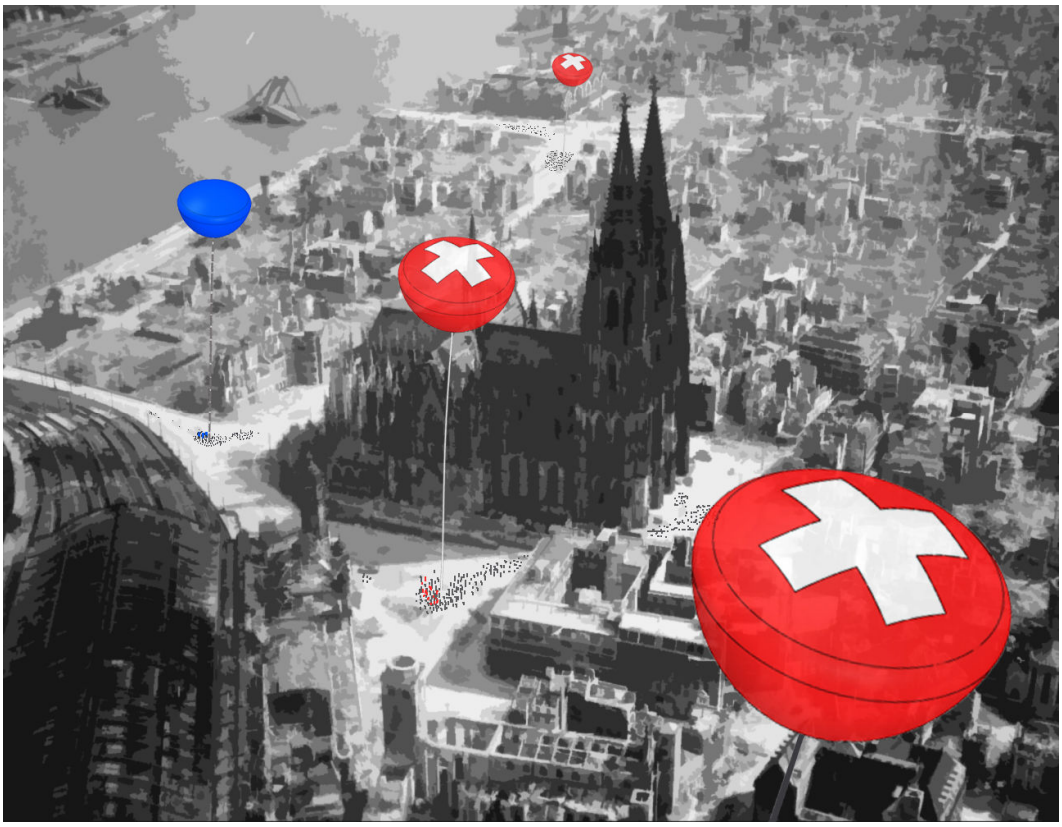

Image 1 I Artist Concept: A trigger for relevant professionals (designers, engineers, researchers, manufacturers) to search for viable solutions; artist concept created by: Eran Lederman.
Image source: The Cologne cathedral stands tall amidst the ruins of the city after allied bombings, 1944, http://rarehistoricalphotos.com/cologne-cathedral-stands-tall-amidst-ruins-city-allied-bombings-1944/.

This concept was a starting point for the research group's conversations with a broad range of stakeholders involved in the conceptual and physical development of this product. A brainstorming process generated a number of scenarios. The first concerns a dramatic event affecting the whole population, aid and supplies are distributed from aid centers dispersed in and around the city. Therefore the goal for the product was to mark of an event, which may span between a few hours to a few days and is managed by the emergency authorities.
An additional scenario envisioned a marathon with some 20,000 runners, and many more thousands of spectators dispersed along the route. The objectives in this scenario would be different, and would involve directing crowds, marking routes and displaying information related to the event. This event would be limited to four or five hours, and the operators would be local actors including the event organizers, local authorities, and police. The principle behind this is generally things that don't work during routine events will not function in the event of an emergency. This scenario demonstrates that the product should be familiar to the public and be in use during routine mass events.

The project was envisioned in a number of versions, from the simplest - passive balloon that can illuminate a point in the sky signifying a place where you can seek medical help or get fresh water and is very cost effective. A more advanced version – the active balloon would have the ability to monitor the environment through photography, gas identification, radio/cellular network rehabilitation, with the capacity to transfer text messages and sound to the surroundings.

To initiate the process and understand the scope of the technical and design challenges the team embarked on a series of experiments to gauge the issues that would need to be addressed in the R&D phase, including aerodynamics, psychology and semiotics, costs, management, as well as visibility. The goal of the first experiment was to reveal the challenges and gaps between the initial idea - the artist concept, and the reality on the ground. The experiment was launched on the shores of the Dead Sea in December 2012, consisting of the launch of a red latex balloon with a 1.5-meter diameter filled with helium and an attached LED flashlight connected to a 50-meter wire (the height was set according to aviation regulations in Israel). The balloon was launched in the late-afternoon and was kept aloft for a number of hours. This first experiment highlighted a number of challenges, including the size of the balloon and its visibility from a distance, aerodynamic issues with stability, and the visibility of the text on the balloon.

A second experiment was conducted in the central part of the Sorek Valley in February 2013. The primary objective of this experiment was to check daytime and nighttime visibility with variations of lighting at different distances. This experiment utilized a red 3.25 cubic meters, 1.8 meter diameter balloon with a sail, flown at a height of 40 meters. This experiment concluded that a 1.8 diameter balloon is highly noticeable up to a distance of 600 meters during the daytime. The addition of striped cable helped draw attention to the and did not significantly contribute towards the tow of the balloon in the wind.

Three significant components needed to be considered in applied design research. The first is the human component including psychology, cultural and ergonomic issues, as well as usability that defines and represents user concerns. The second is the environmental component, which relates to the user environment, such as landscape and topography, climate and time of day. The third is the product component that deals with the characterization of the tools that will serve the user in the environment of use in different scenarios. When we raised various considerations and preferences for each of these components it became apparent that there were conflicts, and the design would need to proceed on a different track than the initial starting point.

Aviation standards limited the height the balloon could be flown to, visibility and cultural semiotics posed challenges to the way the balloon would be interpreted; this lead to the next stage of the applied research and experimental development- taking the constraints and redesigning them into a dialogue that addresses the needs of the urban users.

"Decisions made with broad input from the community will be more popular than those imposed from the top—and probably will be better decisions because they benefit from the local knowledge of those most likely to be affected." (Shah & Ranghieri, 2012,).

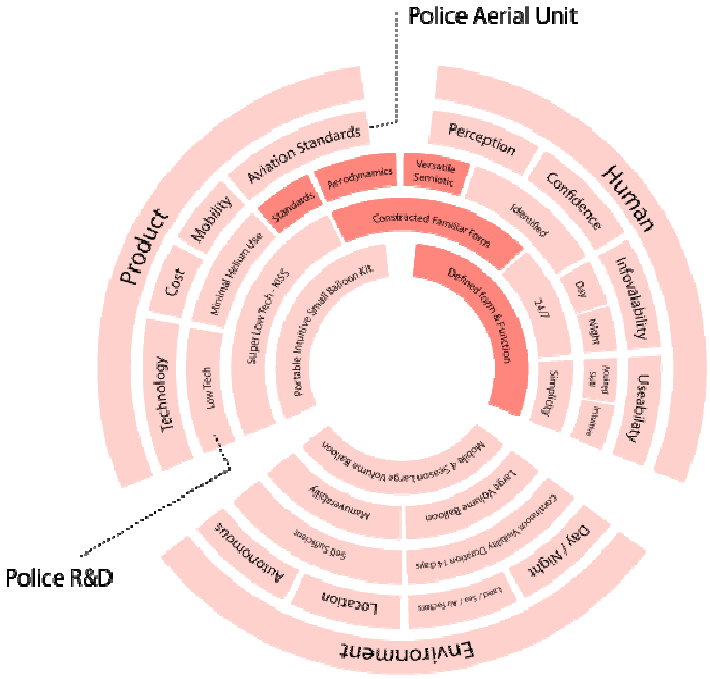

Image 2 I Diagram illustrating the Human, Environment and Product components and the revealed constraints following user feedback.
Image source: Eran Lederman

Image 3 I Nightime visibility of HopeSpot- final experiment, Arazim Valley, 27.3.13
Image source: Eran Lederman

The Integrative Abilities of Design: Linking Languages and Divergent Needs

The engagement of a complex and multidisciplinary web of specialists proved incredibly valuable in refining the design concept, and the iterative process challenged the initial semiotics planned for the balloon. The process used traditional design techniques combined with a co-design process with end users. These end users/ co-designers spanned NGO leaders as well as emergency and response agencies, including police and emergency medical service providers. An advisory board, that included respected figures such as the Global Director of International Development Programs at the Joint Distribution Committee, the Head of Strategic Planning in the Israel Police, and the Disaster Management Coordinator at Magen David Adom (the Israeli equivalent of the Red Cross), and the head of emergency field hospitals in disaster zones, was established to provide feedback to developing ideas, with these experts, professionals and urban users presenting different (at times conflicting) fields of knowledge and practice. The end users/ co-designers offered suggestions and solutions stressing that the product should be as simple as possible, reliable and not expensive, a point that ran counter to the initial vision of an active balloon which could incorporate high-tech elements. Many of these individuals had extensive experience in emergency situations and advised solutions that fit their needs in providing disaster relief.

Cultural interpretations were an additional factor in developing the form of the balloon, while a blimp is a more stable form aerodynamically it can symbolically charged in the city of Jerusalem, where such balloons are used for surveillance during times of political tension and are therefore viewed with suspicion by many residents of East Jerusalem. Though residents of West Jerusalem may view the same blimp with associations of security it was a strategic semiotic choice to design a product that would not be conflated with surveillance and as a result, a rounder balloon shape was deemed more appropriate. Additionally, the light movement that characterizes the form of the balloon contrasting the blimp, which is characterized by stability, is a great advantage as it is easier to identify the system when it is aloft in the sky.

This constraint helped inform the product's appearance. A solution needed to be found that considered urban users' cultural associations through design thinking, and yet it had to be technologically viable. This understanding changed the thinking about some of the core elements of the product, and the focus shifted to the extended cable connected to the balloon and it was redesigned with illuminated LED lights to direct people to aid points on the ground, emphasizing the shifting movement of the balloon, rather than a static point in the sky. Additionally, scientific research offers support suggesting that motion is more efficient in attracting attention (Abrams & Christ, 2003; Gilaie-Dotan, 2016). The balloon itself was also redesigned to be smaller than originally intended; a decision that significantly reduced the amount of helium required and lowered operating costs and complexity. Further thought was given to geographical positioning in the landscape, and topography and vulnerable locations are critical to consider in deciding where to position the balloon.

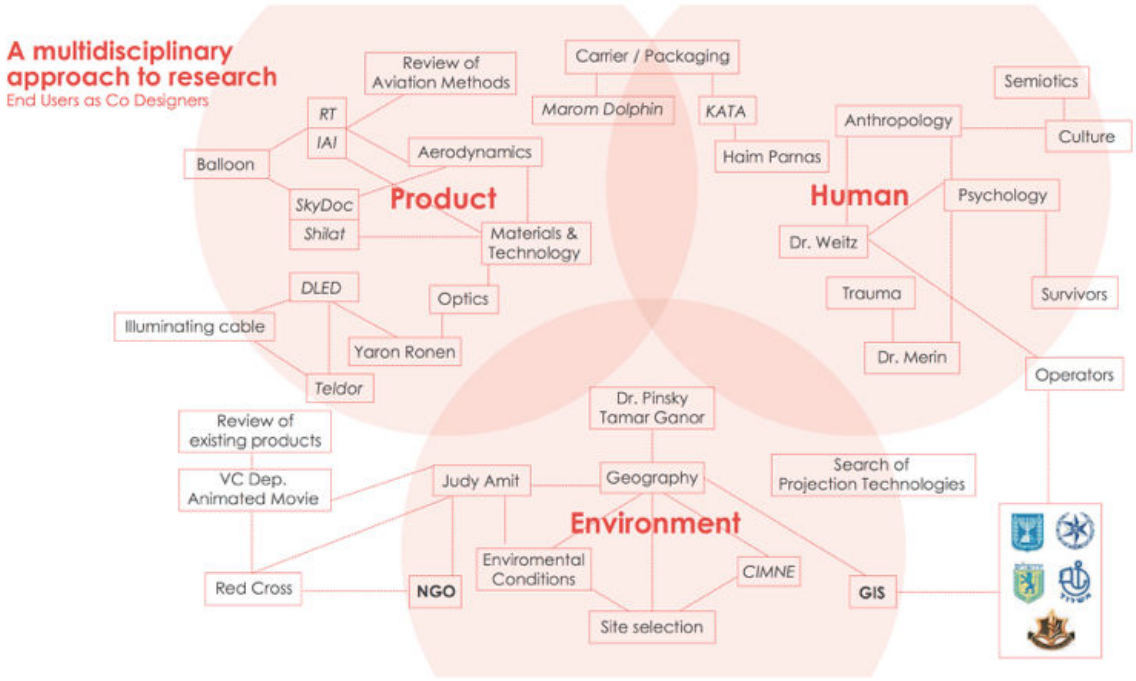

Image 4 I A multidisciplinary approach to the research, mapping end users as co-designers
Image source: Eran Lederman

The current result of this process is the HopeSpot balloon, which reached the proof of concept phase. The HopeSpot is inflated with helium and set aloft to a height of up to 50 meters (the height is set according to aviation regulation in Israel,). It has a distinct hue that is visible in the daytime; the last prototype test reached a daytime visibility of up to 300 meters; while at nighttime an LED light cable points toward the ground with visibility of up to five kilometers. HopeSpot is approximately two meters in diameter and is designed to handle strong wind conditions. The product is water resistant and can be easily controlled by a single individual.
The HopeSpot was piloted at the Jerusalem Marathon in a joint activity with the Jerusalem Municipality and MDA (Magen David Adom, the Israeli affiliate of the Red Cross). The pilot research yielded 82 interviews, including many observations and photographs of the HopeSpot, The Marathon provided an opportunity to observe and interview urban users and security agencies in the context of a real-life security event (Turner, Persov, Weitz, et al., 2014).

Conclusions
Building on the experiences of the *DESURBS* project, we propose constructing integrated teams composed of local and global specialists from different disciplines including academics, research professionals, urban users, emergency agencies, and representatives of the local community. These teams represent a broad platform of knowledge and expertise that can construct a common knowledge language that together have the ability to implement different methods and tools for the specific needs of communities in hazardous situations.
In order to achieve these ambitious goals, a great number of smaller challenges need to be undertaken. It is here that the inter-sectorial communication and collaboration is so important, particularly across different sectors including the private sector, NGOS, academia and government.
In our experience, one of the most efficient meeting points between the experts from the scientific community and the urban users are the local authorities. In this context, it is important to encourage local agencies and urban users to describe their needs regarding the dangers they might be facing, the actions which must be applied and the knowledge they need to be able to cope with these challenges. This, of course, is in addition to

producing, as previously mentioned, a platform of scientific and research knowledge, as wide and deep as possible that allows various communities to explore their specific needs. We believe that adopting industrial design research models and practices can be an applicable framework for solving knowledge gaps in the DRR process. Additionally defining experts, professionals and urban users as viable work teams can offer a new platform for implementing integrated knowledge and designing solutions.

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