1 Executive Summary

Kungshall was built over three hundred years ago in the coastal town of Karlskrona, Sweden. In that time it has served as a fortress for the Swedish Navy, as a slaughterhouse for a growing Baroque city, and as a warehouse for the regional history museum. Six months ago, Volvo Construction Equipment, together with Michano AB, asked us to help them transform this storied building into an innovation center. Volvo, the very definition of a large, traditional, slow-moving company, is interested in addressing the needs of corporate teams that are working on projects that demand rapid and radical design thinking. Michano, the investment arm of the serial entrepreneur Mikael Blomquist, is concerned with encouraging meaningful innovation and business development in his home region.

Drawing from both these inspirations, we envision a creative ecosystem that extends beyond Kungshall in both space and time. Entering Kungshall represents a radical departure from what corporate design teams are used to. To help them embark on this voyage, we welcome them with a Venture Branding Activity – in this space, they shed the shackles of being a team within a large corporation, and are instead a lean and agile start-up, imbued with a name and spirit of their own choosing.

Within Kungshall, teams are surrounded by a fleet of enhanced whiteboards – ‘Verkhölmen’ – that can be gathered as needed, moved and reconfigured – even turned into tables – to shape the space as they want, when they want. Any work teams do on the boards, be it written, post-it, digital, or three-dimensional, is automatically stored and logged in their Cloud Workspace. In this way, the evolution of ideas is automatically charted as a series of connected meetings, and can be browsed as needed. The chart allows others to peer into the inner workings of the design process, and extract useful learnings and insights that might be otherwise lost at sea. When teams return home, although this physical space is left behind, this Cloud Workspace remains the backbone of their project. The structure can be searched to recall old work, or used to present their work. Thus, the entrepreneurial spirit and rapid workflow developed at Kungshall is carried back – and hopefully infects the rest of the corporation.

We arrived at this bold vision after extensive needfinding, benchmarking, prototyping, testing, and iteration. Visiting successful creative spaces, such as SAP AppHaus, during Fall Quarter, we learned that teams that feel special and elite perform like they are, and that teams greatly benefit from co-location and having a space they can customize and truly call their own. Even in the top design firms, such as IDEO, a consistent and meaningful framework for charting the design process doesn’t exist – it is assumed to be tautologically impossible. Furthermore, we saw that technology solutions that purport to help with this, such as the SMARTboard, go unused because they have a high barrier to entry, and teams prefer to just use a regular whiteboard.

In December 2012, we travelled to Sweden, where we visited Kungshall, a number of established design spaces, and talked to several users and stakeholders. This helped us to solidify our persona and their needs. Volvo CEs Technology Working Groups are often formed by plucking people from various departments that have never worked on this
problem or with each other before. They are asked to rapidly and radically innovate, but still have to keep up with their usual daily responsibilities. They need Team Ownership of the problem and design space, in order to feel like a small and agile entrepreneurial venture, and to be motivated to push boundaries. They need a Design Process Capture framework to help keep track of progress, lower the initialization time of each meeting, and as a tool to communicate developments to their bosses. Finally, they also need some measure of Design Process Guidance to help them through the process.

We explored the design space with six prototypes, three of which, Venturoom, Verkholmen, and Process Charting, directly demonstrated the efficacy of this vision.

Venturoom tested both a Venture Branding Activity where teams brainstormed a motto and a name, and were given branded paraphernalia to go along with it, as well as a personalized room that captured work to the Cloud and monitored and encouraged information health. Testing Venturoom confirmed that a unifying brand identity, even manifest in just t-shirts and business cards, helps to improve team spirit and motivation. Furthermore, being able to easily capture work directly to the Cloud was useful, but users demand to be able to Work-To-Cloud from anywhere.

In parallel with Venturoom, we began imagining a chart for the design process, one that allowed viewers to open up the design Black Box, and dive deeper in search for insights and details of work done. Mocking up a chart for our team’s story, as well as interviewing other teams, helped us to clarify what this chart requires – more than just input/output blocks, it needs to accommodate external influences such as directives from corporate bosses, as well as be easy for teams to customize to their needs. Just from seeing how we were trying to fit their story into our sort of chart, through shaped questions and quick sketches, teams felt that they were already becoming more conscious of their design process – an encouraging indicator that we are heading down the right path.

The learnings from Venturoom drove us to create the Verkholmen concept. We built a prototype that implemented most of the key features laid out in the vision: transformation between table and board, capture of physical work done on surface to the Cloud, and design guidance and meeting structure templates. Through user testing, we discovered that we had successfully preserved the physical experience of writing on a whiteboard – it felt natural to users in both table and board mode. We learned that our physical form needs to set strict expectations for use: it should look like what it is and nothing more, lest users try to use it as a touchscreen or speak into it. Furthermore, we discovered that users want more – they demand more structure and organization to the captured images that are stored on the Cloud. We believe that this framework should be based on the Process Chart we are beginning to develop.

Looking forward to EXPE, we expect to demonstrate a fully working Verkholmen, as well as create the spatial experience of a fleet of them by using some non-smart versions. The physicality of the Verkholmen prototype will be fully refined, while we expect that the software will be the minimum viable product needed to showcase useful features – but with just a touch of the ‘wow’ factor. We will be satisfied with the outcome of this project if we can create a delightful and surprisingly wonderful experience that helps users be more mindful of the design process.

Indeed, we are extraordinarily excited for the upcoming quarter, and hope that our final product will become charged with this same energy – and be able to create a truly electric experience.
Figure 1.1: Vision for Kungshall

Figure 1.2: Verkholmen Prototype
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Glossary

10HM (Ten hour meeting) The identified opportunity to find a way for 10 one-hour meetings, scattered over the course of a year, to achieve the efficiency of one 10-hour meeting. This is a real issue among innovation teams and other small task force teams that only meet occasionally throughout the year to check in regarding low-priority projects. Talks with Volvo employees have revealed that any way of eliminating the meeting initialization time would have immediate recognized value. See Meeting initialization time.

ALMI Government-sponsored venture capital funding for small business in Sweden. Providing both advice and financial support for start-ups, its stated mission is to provide a level playing field for Swedish businesses. At the same time, it is understood that the loans are high-risk and have high interest rates; this encourages honesty because if an idea is bad and a startup is likely to fail, it is in the team’s best interest to kill it.

Ambient stimuli Abstract cues (including light, sound, movement) provided by a space that encourage users in a brainstorm room or other creative space designed to energize and inspire teams. See Prototyping: experience prototyping: ambient cues.

Blocking behavior Identified in Neeraj Sonalkar’s work as an action by a designer that inhibits a team’s creative flow by shutting down a teammate’s idea. See Appendix: Fall Interviews: Neeraj Sonalkar.

Creative sanctuary Our vision for what Kungshall would be for all user groups. See Introduction: Vision.

D.box A potential product we’re considering offering teams before they come to the space - a ‘starter kit’ to introduce them to design thinking before they arrive as Kungshall.

Design sensei Highly experienced design thinking academics or professionals who come to Kungshall for a number of months to act as mentors or to use the space as a design observatory. These are the Marks and Larrys of our space.

Design sherpa A facilitator in the Kungshall space, this person is a design thinking evangelist who is enthusiastic about teaching design thinking to newcomers and, while they may not be an accomplished academic in the way that a design sensei is, has a broad range of experience guiding teams through the design process. Over the course of this quarter, we have come to realize that the Verkholmen table could take on much of this role, so we are reconsidering what our staffing recommendations for the space will be.

Feature creep Common term in software design referring to the constant addition of new features to a product, due to the fact that users will always want software to do more. This challenge became extremely relevant during our user testing of the Verkholmen table: extra features that go beyond the basic function of a product can lead it to be excessively complicated, and with a small design team such as ours,
trying to satisfy demands for too many features can spread resources too thin and lead to mediocre quality of all features rather than mastery of a few.

**Hand-holding** The amount of design thinking guidance and feedback that a user of Kungshall should get, based on his experience level, in order to achieve a happy medium between getting the support he needs and receiving advice that feels so simple/obvious that it is boring, inane, or insulting. We are functioning under the general assumption that new would-be entrepreneurs will need far more hand-holding than other users. See also: Modular design thinking framework.

**iGroup or Corporate splinter team or Satellite team** Identified as our main user, this is a small group from a large company that has been tasked with delivering innovation around a specific prompt or challenge on a short timescale.

**Information health flower** A visual display which, as part of the venturoom prototype, indicated how well-tagged the team’s documentation was. The idea here was to encourage teams to organize their documentation by making the connection between lack of tagging and lack of quick access to the information - it withers and dies over time as it loses connectivity with the current project path. See Funk-tional system prototype, Team process map.

**Innovation task** It is assumed that each team coming into Kungshall has been sent with a specific purpose, either self-defined (in the case of small start-ups and individual entrepreneurs) or handed down from higher management (in the case of corporate splinter teams).

**Knowledge broker** The role of connecting a team with information about related or analogous projects, experiences, or work. This may be a person, a forum, or some element of the space itself. Based on the idea that some of the best innovation comes from recombination or repurposing old ideas. The main idea here is to inspire, avoid ‘reinventing the wheel,’ and save time/energy by creating connections between teams and sources of knowledge about a given problem space.

**Kungshall canals** An initial idea for our Trains prototype, where a conveyor system (possibly small sushi boats’ on canals, a conveyor belt, or gondola system) would circulate prototyping materials and semi-finished prototypes throughout the Kungshall space. The physical movement of materials and prototypes was meant to provide a constant source of inspiration and novelty, and connect teams using the space to each other and to visitors in Kungshall’s Cafe.

**Lagom** Traditional Swedish ethic of social equality and taking only as much for oneself as needed; this pervades all aspects of Swedish culture, including the entrepreneurship scene. While this makes for a very honest culture, it can also mean that startup teams’ aspirations are limited, as they try to avoid being greedy.

**Legacy** The way that the space communicates previous successes to inspire the current users of Kungshall. Inspired by the wealth of old prototypes and posters in the ME310 Loft.
**Lost at sea** The fate of most ideas that an innovation team comes up with and chooses not to pursue for a variety of reasons - personal preferences, inappropriateness for the project, lack of knowledge or resources in that specific area - but would be great candidates for being carried forward by other teams or at a later time. Because the team focuses on another idea, these ideas risk being lost in a sea of discarded ideas forever. Our goal is to rescue these via our documentation system by making them more accessible and making it more convenient and common for higher management to review the masses of ideas that were not pursued in the development of a project.

**Meaningful idea** Where to begin? In Kungshall’s quest to encourage creativity, it is essential not only to encourage a greater number of ideas, but to guarantee the quality of those ideas - i.e., not just generating nonsense ideas to meet numbers (although this approach does also increase the chance of getting a few more ideas out of the noise). Our current way to quantify ‘meaningfulness’ is by the number of other ideas a given idea leads/links to; this is because a ‘good’ idea should inspire other ideas, while a ‘dud’ idea should be a dead end.

**Meeting initialization time** The time that a team takes to set up their meeting space and return to the state in which they had left their previous meeting - this includes finding all necessary materials, recalling what they had been working on last, and regaining their work stride’. See also 10HM.

**Microclimate** A personalized environment that a team is able to set up for themselves, based on their desired working conditions. Our prototyping throughout winter quarter focused on different methods of shaping a team’s microclimate and what effects these might have.

**Momentum Problem** The challenge of trying to keep up the energy, enthusiasm, and pace of work in a team after leaving a space like Kungshall. Transitioning back to a team’s normal’ workspace is challenging, and especially if there is not a clearly defined path forward for the team, many projects tend to die from lack of momentum when the team is no longer co-located and dedicating large amounts of time to the challenge.

**Modular design thinking framework** One of the main offerings of the Kungshall space, this contains the set of design thinking tools, techniques, and advice similar to what that students in ME310 receive, except that the offerings would be catered to the user’s needs to achieve the appropriate amount of hand-holding.

**Persistent cloudspace** The space set up for a team to store the information they generate from their Verkholmen (and from any other places they wish to store information). This space persists after the team has left Kungshall, providing a permanent record which can be quickly referenced as well as presented off of. All information in the cloudspace is tagged and structured as a reorganizable Team process map.

**Protoprototype, protoprotoprototype, etc.** the prototype of a prototype, the prototype of a prototype of a prototype.
Safe cave feeling  The experience of being in a small, enclosed brainstorming space that offers privacy and an escape from the outside world. We were shocked by how positively teams responded to having a space like this. See Appendix: Fall quarter experience prototyping.

Scrolling whiteboard  A product we invented where a scroll of whiteboard material creates a writing surface that is continuously replenishable (as well as rewindable) with an automatically-triggered documentation device to capture material on it. See prototyping: physical prototyping: conclusions.

Smartboard trap  The problem which products like the SmartBoard face: the technology generates initial excitement, and is incredibly successful in theory, but ends up falling into disuse because over time, the minor annoyance of using the technology exceeds the perceived benefit.

(Space) customization or tinkering  Adjustments made to the physical environment of Kungshall by the people using it: the success of the community feeling in the space depends on individuals taking ownership of the space.

Space plus  General term developed during fall quarter for what the Kungshall space can offer beyond the physical environment; something about the space that makes teams act differently than they would in any other setting and creates a truly unique innovation environment.

Special forces team  This refers to the feeling we want to create for teams within our space. The theory is that a team who feels they are on a special forces task will behave like a special forces team - ie, perform better. See Appendix: Fall interviews: Philipp Skogstad.

Team process map  A customized map, organizing the development process that a team went through on a specific innovation task. All information in the personalized cloudspace is stored here, and tags on the information make it searchable and reorganizable.

Trains  Generic term for our prototype investigating the effect of movement in a workspace on team dynamics. Some users responded very positively to the stimulus of having moving toy trains in their space, while some found them massively frustrating. See Dark Horse prototype.

Unplanned interactions  Unexpected interactions between different users of a space who would not normally collaborate, potentially leading to radical innovation. Might be created or supported by the Kungshall space design. See Appendix: Fall interviews: Andy Switky. Or go see the Pixar Headquarters, which are famous for doing this.

Venture branding  Teams entering Kungshall will be guided through this bonding activity where they define as a team what their goals are for the project they’re working on. From this, a venture identity will be formed. There are a few goals of this activity: to help them get to know each other better; to start a discussion about their
motivations so that the team better understands each other and is aligned around a common goal; to give them the feeling and agility associated with being a start-up venture; and to give them a feeling of autonomy, that they (rather than their parent corporation) have control over their goals and direction.

**Venturoom** Generic term for the system prototype in which we built a customizable smart workspace for teams that had gone through a *venture branding activity*. The Venturoom prototype consisted of an RFID scanner at the door to identify which team was tagging in, lights which would turn on to the team's preferred color and tempo settings, a projection space which displayed a control panel with the team's most recent work, and a whiteboard with a smart eraser that controlled a camera to document all written work before it was erased. See **Funktional system prototype**.

**Verkholmen** (pl. *Verkholmen*) Our proposed solution, an enhanced whiteboard that combines a traditional whiteboard writing surface with a customizable, interactive backdrop screen and a camera system to document work done on the board. The board can function as a standalone workspace or be used in conjunction with other boards to shape a space and make a customized room for a team to work in; in addition, each individual board can be rotated between horizontal (table) and vertical (wall) configurations. **Etymology**: Swedish, verk (work) + holmen (island): *this name originated from the idea that we could combine all of the elements in the Venturoom to become one small work island. Each smart whiteboard could function as a standalone workspace or as part of a larger 'archipelago'*.  

**Work-to-Cloud** The assumption that all work done on Verkholmen is automatically documented in the team's **Persistent cloudspace**.
2 Context

2.1 Need Statement

The formation of radical innovation teams within large established corporations, though much desired, is an uphill battle: the team has to swim against the surging currents of large inertia and burdensome beaurocratic overhead. Team members are often assembled from different departments and sometimes even different countries, and have to work around the intersection of many schedules and timezones. Often, although experienced in their fields, these teams are new to design thinking.

Some teams have been successful in solving these problems by going off on their own and establishing a separate office. But the barrier to entry, both in terms of time and capital investment, is large, and the risk high. What if they could simply rent a space to call their own, far away from meddling micromanagement? A space that is built to encourage innovation, where they can get design thinking help tailored to fit their goals. And it isn’t just corporate splinter teams that need a space like this – start-ups and solo entrepreneurs would find a home there too.

The Kungshall Innovation Center will be used by a variety of teams from different backgrounds (see earlier fall quarter brainstorming regarding this in Appendix: User Chart), and a crucial feature of our system is that it is flexible enough to provide appropriate support to these various experience levels. To give our team focus, this quarter we focused specifically on the needs of the user that we felt would make up the largest part of our demographic, and which we understood most thoroughly: ‘Splinter teams’ coming from a large company such as Volvo.

Traveling to Sweden and speaking with representatives from Volvo helped us define our user and the needs that we are addressing (See Appendix - Interview with Peter Wallin). We came to realize that there are actually two sets of needs we need to consider - the needs from the perspective of the team members and from the perspective of their parent company.

From their own perspective, ventures entering Kungshall need to:

- **Feel autonomy and control over their project.** Many innovation projects have been assigned to teams by higher levels of management, and innovation teams have trouble feeling excitement about their work because the given requirements for the project are so strict that teams do not feel ownership of the idea. This environment is stifling to innovation; leaving the naturally oppressive office environment (where there are always higher managers around, and even with the best intentions will end up controlling the project direction) empowers teams to define the direction of their project and work on something that they feel strongly about. This helps them work with a level of passion that they would be unable to achieve at their parent office.

- **Effectively communicate the value of the work they have produced.** Innovation teams that come to Kungshall face a number of barriers when bringing their work back to the parent companies: in addition to the stress of being expected to
deliver innovation is the challenge of justifying the validity of these radical ideas and communicating both the value of the work which yielded them and the value of the design thinking process in general. Users in Sweden have repeatedly voiced the need to communicate to outsiders that Kungshall is not just about having fun: design thinking often does not appear particularly serious or sophisticated, and it can cause tension when users try to bring ideas back to their parent companies and implement them. This compounds a preexisting challenge that we have heard voiced by other users: the momentum problem. Especially when there are not clear roles for who is responsible for taking the project forward, or the company structure has not set time aside for designated employees to work on implementation, it is common for these sorts of projects to ‘fizzle out’ when team members return to their normal schedules. (See glossary: **Momentum problem**) The final aspect of this need is to be able to efficiently communicate ideas that were developed along the way during the design process, so that they do not become lost at sea. A huge amount of energy and potential is lost in ideas that do not get carried forward, and there are no structures currently in place for rescuing these ideas. This could ease the transition back to a parent company when management does not support the direction that the team chose at Kungshall: having access to earlier iterations of ideas could be hugely valuable so that the time and work at Kungshall did not feel wasted. (See glossary: **Lost at sea**)

- **Work more efficiently as a team than they could at their parent company**

In everyone we interviewed, there was agreement that certain factors universally make it hard for a team to work at maximum efficiency. Among these are scheduling a time when the team is all available to meet; maintaining a high level of focus on projects that are not top priority (especially given the stress of other projects that seem more urgent and stressful); and the time and effort spent catching the team up and recalling where they were when they left off at the last meeting. Exacerbating this problem in many innovation teams is the fact that the team members often have not worked together before, or even met each other. Getting used to each other’s work styles, understanding motivations, and aligning goals can take a huge amount of time and energy. (See glossary definitions for **Meeting initialization time** and **10HM**; to see how we have addressed this need, skip ahead to Prototype. Venture branding activity).

These needs can be seen as limiting factors - things that frustrate team members, block cooperation, and make it challenging to move forward with the project - or they can be seen as opportunities to leverage the physical move to the Kungshall space to ‘start over’ and change attitudes to make teams more innovative and successful. Being co-located can help teams focus more intensely, reduce time wasted navigating scheduling conflicts; and introduce a new level of autonomy by physically separating them from their parent company. Much of our prototyping effort this quarter was focused around leveraging and enhancing these advantages. See **Venture Branding Activity** for a further discussion of how we explored this.

The needs from the parent company’s perspective, as deduced from conversations with Volvo CE employees, iGroup facilitators, and our liaisons, are slightly different:
• To find solutions which demonstrate clear value to the customer. Discussions with the manager of Volvo CE’s Innovation Portfolio manager indicated that this would be his biggest priority when sending teams into the space. For him, the main draw of the space would be to help his teams stay in touch with their customer’s needs, and he would need to see clear demonstration of this in the work coming out of the space. (See Appendix 1A. Notes from discussion with Peter Wallin)

• Increased clarity around what employees are doing in the Kungshall space and proof that being in the space makes them more productive. This is actually a need voiced by all stakeholders in our project: our sponsors and liaisons want to be able to demonstrate the value of sending teams to the space; customers want to demonstrate that they have been working effectively and not just ‘goofing around’ with design thinking; and companies want confirmation that their investment (financial, and of their employees’ time) in sending groups to this space was worthwhile.

• To reinvigorate employees and convert them to design thinking evangelists within their normal work environment. The material and attitudes they learn during their time at Kungshall should extend beyond just their time at Kungshall. There is potential for the investment to pay itself back many times and have a much larger influence if alumni of the Kungshall space can continue to spread the work they’ve done. From the perspective of the Kungshall space, this need is also extremely important: in order to stay relevant on a global basis, Kungshall must maintain its influence and ties beyond just the people in the space at a given time.

2.2 Existing resources for independent innovators in Sweden

The Swedish entrepreneurial environment is unique in that it fosters a more forgiving, accepting environment than that of Silicon Valley - but at the same time, small companies do not grow as fast because it is generally not as connected, not as many opportunities. The Swedish startup environment tends to be more considered: people work slowly, take more time to listen and consider proposals, and therefore tend to be less aggressive in their approach to new businesses. Throughout the startup environment, the concept of lagom pervades.

On a tour of Malmo, one of the main centers for entrepreneurs in Sweden, an advisor at an incubator described the trajectory of startups as a linear progression through the following set of resources:

![Figure 2.1: Resources available to small ventures in Malmo](image)
2.3 Existing resources for innovators within a company like Volvo CE

Stpln (Stappelbaden) is a general open space for people that do not have offices: it has some workspaces with couches and desks; some tools for basic prototyping, and some meeting rooms. All work is self-structured and there is no coaching or oversight. Once teams have organized their idea and are ready to pitch it, they would move on to a place like MINC, a typical startup incubator as we know them in Silicon Valley; once teams have progressed through this and no longer need serious coaching, they move on to a space like MEC, which is essentially just office space for small business with a good ‘vibe’ and that attracts a crowd of people interested in innovation and small enterprises.

Another unique feature of the Swedish innovation scene is ALMI, an organization associated with the Swedish government that provides funding and coaching to start-ups. Because the amount of funding available through ALMI is small, it is easy to obtain. Larger amounts of money for promising ventures are available through sources like our corporate partner, Mikael Blomqvist; interestingly, discussions with him indicated that the limiting factor in the Swedish entrepreneurial environment is not the amount of funding available, but the scale at which small ventures dare to dream. This is partially due to the Swedish cultural tradition of lagom.

2.3 Existing resources for innovators within a company like Volvo CE

Large companies like Volvo CE often put very little emphasis on radical innovation and design thinking. The structure at Volvo CE, as explained by Innovation Portfolio Manager Peter Wallin, uses Technology Working Groups, assigned to deliver innovation around a specific topic or area, which meet a few times a year to work on specific projects. This work ends up being a very small fraction of an employee’s time, and groups only meet for a total of a few hours per year. The emphasis is generally on incremental improvement rather than radical innovations in their product line; the groups’ top priority is bringing more value to the customer, but not generally through ground-shaking measures. For full notes from our interview with Peter Wallin, see Appendix - Interview with Peter Wallin.

2.4 Problem Statement

The Kungshall warehouse was built in 1787 on a naval bastion off the city of Karlskrona in south Sweden. Nestled in coastal isolation, it is four hours east of Copenhagen, and 6 hours south of Stockholm, the nearest cities. It has served for hundreds of years as a munitions store – but now Volvo Construction Equipment and Michano AB have asked us to help transform it into a groundbreaking new innovation space.

It is paramount that we take advantage of both this storied past and this uniquely idyllic, if isolated, location. It has to have much more than just beautiful interior design and fancy furniture – what can we offer that would make teams travel this great distance to the middle of nowhere? What can we offer beyond just space – what can we offer that is SPACE+?

Our vision video from our winter presentation gives a concise explanation of our user, the most important needs, and our vision of how this solution might address them.
2.5 Corporate Partners

2.5.1 Volvo Construction Equipment

Volvo CE is a large and complex international company with a seemingly simple goal: build construction equipment. From diggers to backhoes and front-end loaders, they are world-leaders in several market segments, and are always looking to innovative advances to keep their edge. They want to improve their ability to be innovative, and so are very interested in the results and methods of the Kungshall project.

2.5.2 Michano AB

Mikael Blomqvist, founder of Michano AB, is a highly succesful Swedish serial entrepreneur who founded and then sold two companies: Metget, an RFID technology firm, and Roxtec, a cable isolation manufacturer. Now, he is a board member at Blekinge Institute of Technology, and chairman of cloud storage company Compuverde. He is interested in understanding and stimulating the design and innovation processes, and is the primary investor in Kungshall.

2.6 Design Team

After a wildly successful Paper Bikes competition, the majority of Stanford’s famous Team 8 Domin8 decided to stick together for the corporate project. The Swedish side of the equation consists of three supremely qualified PhD students with valuable experience in innovation and sustainability research.

EVA HOFFMANN
M.E. Graduate Student at Stanford University
ehof@stanford.edu

Originally from New York City, I came to Stanford five years ago to do my undergraduate degree. I started out in Human Biology (studying ecology and environmental change), but I have always loved making things and became more and more involved in Product Design, following along with the undergrad PD program until I was accepted as an ME Coterm MS student. I’m especially interested in affordable design for the developing world, and so it’s been really exciting to see my interests come together; having a background in human health and environment/energy resources has been so helpful for all the projects I’ve worked on. After finishing my undergraduate degree,
I took a leave of absence for a year to gain some work experience. During this time, I was briefly on a disease research project in rural Kenya; then working with an interior design firm in Cambodia; and then doing manufacturing work with some 310 alumni at Proximity Designs in Burma. My work in Burma especially cemented my realization of how important it is for me to have experiences like the 310 series - I still have so much more to learn about project management, working with corporate partners, and how to take products from problem statement to concept to implementation.

Jonathan Goh  
M.E. Graduate Student at Stanford University  
jgoh@stanford.edu

I am from Vancouver, British Columbia, Canada. I did my undergrad at Princeton, where I majored in Mech E and minored in Visual Arts and some other random stuff like Physics. I love, love, love making things! I also love skiing. I have yet to do both at the same time, but I believe it would be a transcendental experience.

My core skills are graphic/CAD design/3d rendering and manual/CAM manufacturing. I love machine and wood shop, and am proficient with manual tools and also 3- and 4-axis CNC machines. I also have experience with programming microprocessors, 3d printing, and composites layup. www.finestruktur.com is my personal webpage, and has lots of pretty pictures about stuff I have made in the past!

Aditya Rao  
M.E. Graduate Student at Stanford University  
adirao@stanford.edu
I am originally from Bangalore, India. I came to Stanford straight out of an undergrad in Mechanical Engineering (Design and Manufacturing) that I completed back home. I play a lot of sports, love Scuba Diving and taking apart stuff and putting said stuff back together (or not). I think my inclination for design stems from being a lego-addict as a toddler. I have always loved building and tinkering with things. When it came time to choose an undergrad major, I figured ME would be a great place to start to get into creating and building products and eventually transition into Design. I have had a ton of design experiences during my undergrad including building an autonomous hovercraft that won us 2nd at National Competition. I also worked on building a "pico wind energy harvester" right from the ideation phase to building a fully working prototype. Some other amazing experiences were during my internship stints at 2 Design Consultancies and the Power Tools Design Dept at Bosch. They gave me an insight into how professional teams go through the design process and the nitty grittys of working with clients.

Mikael Johnsson
PhD Student at Malardalen University
mikael@munktellsciencepark.se

Mikael is currently a PhD student at Malardalen University. He is working at Munktell Science Park at Eskilstuna, where he is conducting research on untapped innovation capacity in employees’ daily work. He has worked extensively as a consultant on innovation projects, has co-founded several innovation-focused companies, and holds several patents.
2.6. Design Team

Massimo Panarotto
PhD Student at Blekinge Institute
massimo.panarotto@bth.se

Originally from Italy, Massimo is currently a PhD student at Blekinge Institute, where he is doing research in the Product Development Research Laboratory. He has an MSc in mechanical engineering from the University of Padova, Italy. He worked on his master’s thesis, ‘Creative Methods for Sustainability Driven Innovation’, during an exchange program year at Lulea University, Sweden. Massimo previously played soccer in the 8th division of the National Italian Football association, and now enjoys coaching the sport. He also enjoys fishing, watching movies, and playing the guitar and harmonica.

Andre Benaim
PhD Student at Blekinge Institute
andre.benaim@bth.se

Originally from Sao Paolo, Brazil, Andre is currently a PhD student at Blekinge Institute, where he is doing research in the Product Development Research Laboratory. He received his Bachelor of Law from Universidade Presbiteriana Mackenzie in 2006, and a MSc in Strategic Leadership Towards Sustainability in 2008 from BTH.

He is interested in human and organizational development towards sustainability, and has previously volunteered for the Global Action Plan (GAP) International.

Special thanks to our ME310 coach, Tim Yoon and our corporate liaisons, Tobias and Andreas Larsson.
3 Design Requirements

Introduction

Going into this project, our prompt, while simple, was not well defined. Hence we did not have any given requirements to start with. However, talking to Mikael Blomqvist (see Appendix: Interview with Mikael Blomqvist) has helped us gain an understanding of the things that are important to him. For example, he wants to foster a 'maker' culture in his home region. This was a good stepping stone to defining our design requirements in the fall quarter. Since then, we have gone through many cycles of prototyping, and have gained a deeper understanding of user needs. This helped us formulate our design requirements for our vision of Kungshall. An integral part of the vision we foresee is a tool, for example the Verkholmen, that will be central to aiding users innovate in the space.

The various functional and physical requirements for such a tool and the system it is a part of is enumerated in the tables following.
### 3.1 Functional Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Metric</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seamless auto-documentation of design process</td>
<td>$\frac{\Delta Value}{\Delta Annoyance} \gg 1$</td>
<td>Documenting the design process manually is difficult and breaks the flow of the process. Being able to do it automatically, while adding value is beneficial especially as an empirical record of the process for future use.</td>
</tr>
<tr>
<td>User expectations are shaped by the design (WYSIWYG)</td>
<td>100% of users do not try and use any feature that does not exist</td>
<td>Shaping user expectations is important in defining how the tool is used. Not living up to user expectations will lead to disappointment in the tool.</td>
</tr>
<tr>
<td>User interface is simple and intuitive to navigate</td>
<td>Users can navigate through 100% of available modes with zero external instruction</td>
<td>A complicated user interface will detract from the design process and increase barrier to using the tool.</td>
</tr>
<tr>
<td>Encourage standing in table mode</td>
<td>Height of table is between 36” and 42”</td>
<td>Standing during meetings/brainstorms brings more energy to the conversation.</td>
</tr>
<tr>
<td>Design process guidance is adaptable to experience</td>
<td>Users are not guided through steps in the design process that they are comfortable with</td>
<td>Giving guidance to experienced users when they do not need it can feel patronizing and off-putting.</td>
</tr>
<tr>
<td>Verkolmen always have access to information on the cloud</td>
<td>20mb temporary cache memory in case of failure of connection to the inter-webs</td>
<td>Not having access to critical information on the cloud at all times could hamper team progress and lead to inefficiency.</td>
</tr>
<tr>
<td>User expectations are shaped by the design (WYSYWIG)</td>
<td>User does not try and use any feature that does not exist</td>
<td>Shaping user expectations is an important step in...</td>
</tr>
</tbody>
</table>
### Design Requirements

<table>
<thead>
<tr>
<th>Procedure to switch between vertical and horizontal modes should be self-explanatory</th>
<th>User can switch between modes without instruction</th>
<th>A complex procedure to switch between modes would lead to one mode being unused/underused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical space can be customized/sculpted to suit user needs</td>
<td>Any enclosed space needed can be set up in 5min</td>
<td>The ability to mold the physical space gives teams the freedom</td>
</tr>
</tbody>
</table>

#### 3.1.1 Functional Constraints

1. Users expect a minimum of horizontal and vertical surfaces to work on
2. Standard table and whiteboard experiences are retained while using the tool as either.

#### 3.1.2 Functional Opportunities

1. Use documentation generated to convey and explore lost ideas during the process
2. Verkholmen could be connected and talk to each for added functionality
3. Templates guiding users through the process can evolve based on user needs
4. Users can tag information as a system to organize data
5. Ambient stimulus could be used to help inspire a team
6. Images captured are converted to text with post processing
7. Have a mechanism to catch any objects on tool to speed up the transition between modes
### 3.2 Physical Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Metric</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image capturing trigger is easily accessible</td>
<td>Any user can capture an image through a single step process and within 3 sec of needing to do so</td>
<td>Cumbersome image capture would lead to disuse or frustration with the tool</td>
</tr>
<tr>
<td>Image displayed should be sharp and bright</td>
<td>A user can read 10pt text on the display from 5 ft away</td>
<td>A poor quality display will render the image useless</td>
</tr>
<tr>
<td>Captured image is of high quality</td>
<td>Image is captured at 100 pixels/inch at the minimum with less than 5% distortion</td>
<td>Images would only be useful if data that has been captured is legible and easily understood</td>
</tr>
<tr>
<td>Switching between vertical and horizontal mode should not be a physical burden</td>
<td>A single user should be able to transform table using less than 50N (11 lbf) force.</td>
<td>Physical effort required to transform tool would lead to one mode being underused</td>
</tr>
<tr>
<td>The size of the tool is not overwhelmingly large</td>
<td>Projected surface area of the base of the tool does not exceed 6 ft * 3 ft</td>
<td>A large tool would be unwieldy and could intimidate users</td>
</tr>
<tr>
<td>Transforming mechanism should be robust</td>
<td>Fatigue life of mechanism should be greater than $10^{-4}$ cycles</td>
<td>A damaged mechanism would render the tool unusable</td>
</tr>
<tr>
<td>The tool is durable and can endure rough usage</td>
<td>Should be able to withstand up to 120 kgf in the horizontal or vertical direction without failing</td>
<td>In a design space it is important that the furniture can be abused by users to a certain extent to help them take ownership of their space</td>
</tr>
<tr>
<td>The tool should be easy to move</td>
<td>A single user can move the tool unit 50 ft before getting fatigued</td>
<td>The units will have to be moved around in order to reorganize and sculpt physical space.</td>
</tr>
</tbody>
</table>
3.2.1 Physical Constraints

1. Kungshall is laid out like a warehouse with large open spaces and a built up area of about 2500sqm
2. Physical size of the tool is limited by typical human height and reach.

3.2.2 Physical Opportunities

1. The tool could be used in different tilted positions between the horizontal and vertical.
2. The height of the tool is adjustable
3. Motorized system to aid automatic transition between modes
4 Design Development

4.0.1 Overview

Development took place in three broad stages – needfinding, prototyping, and testing.

The needfinding phase included user interviews, benchmarking of existing solutions, and a site visit to Kungshall.

In Fall Quarter, we visited successful design spaces in Silicon Valley. The details and results of these visits can be found in more detail in the Appendix; a summary is included here. From our visit to SAP Apphaus, where we talked to Philip Skogstad, we learnt the value of a ‘special forces feeling’ – teams that feel like they are elite tend to perform like they are. We also learned that teams function best when they are co-located, and have the flexibility to customize their physical space as they desire. We also visited IDEO, where we learned that best designers don’t expect much from their space – just a simple place to work in, and abundant pens and pads of Post-Its. From both these places, we learned that there isn’t an established way to keep track of the design process in even the most experienced and elite of firms – it is left up to the designer and is often messy, and assumed a priori to be tautologically intractable.

The places we visited all had advanced tools like the Smartboard that are meant to make keeping track of work easier. However, users reported that they most often went unused, because they had too high of a barrier to entry. Teams would use a regular whiteboard instead, as it was easier and intuitive. Although using the Smartboard would have paid off over time, as the work grew and keeping track of it became more important, the added value at the time is too low to make the annoyance worthwhile. Benchmarking a few of these tools ourselves (described much more thoroughly in the Appendix), we found a similar result. This lead us to the important criteria for process capture tools of have the incremental added value be larger than the incremental added annoyance:

\[
\frac{\Delta Value}{\Delta Annoyance} \geq 1
\]  

In December 2012, we visited Sweden. There, we visited established creative spaces to understand the existing solution space and the local business environment. We talked to a number of users, including Peter Wallin, an Innovation Portfolio Manager at Volvo CE, which helped us solidify our Needs Statement (See Chapter 2). He described these Technology Working Groups as being formed by picking individuals from several departments who had often never worked on the project before, or with each other. They start out with no ownership of the problem or design space, and also have to continue doing their daily tasks which leaves little to no time for the project. Scheduling is a huge issue, and they tend to meet once a week for perhaps an hour at best. Being head of the Groups, he had the authority to set criteria for what a ‘useful’ space – one they would actually send a team to – would consist of. He would like some ability to measure the output of Kungshall, something to show that value is being added there, rather than just a soft
workshop where skills are developed. For more about these needs, see Chapter 2. For more about the interview with Peter, please see the Appendix.

A total of five prototypes were built and tested to explore the space. The Critical Experience Prototype (CEP) and Critical Function Prototype (CFP) were early explorations of the design space conducted in the Fall Quarter.

During the fall quarter, we began to broadly explore the design space with the Critical Experience Prototype, more usefully known as ‘The Brainhurricane Room’, and the Critical Function Prototype, the ‘Scrolling Table’. The development, testing, and lessons from these prototypes are described in detail in the appendix; the most relevant details are summarized here.

For the ‘Brainhurricane Room’, we walled off a section of the ME310 Loft with curtains, and set up a projector and speakers to create ambient environmental stimuli. After testing a number of different scenarios with both semantic and non-semantic stimulus geared to help teams brainstorm, we learned that trying to help teams with semantic cues was very difficult, but inspiring the designers themselves with non-semantic stimuli – such as upbeat music and colourful videos – can have a large positive effect on team performance.

For the ‘Scrolling Table’, we covered an IKEA table with a roll of writable whiteboard material and a scrolling mechanism. Work done on the table didn’t have to be erased – you could advance the scroll by turning a winch, and then write on the new material. A digital camera located under the table could be commanded to take a picture of the old material. We were aiming to discover whether the physical experience of writing on a whiteboard could be preserved, and we found that it could even be enhanced: the physical act of advancing the roll was gratifying. Using the digital camera to take photographs of the rolled material was a first crude exploration of automatic capture of work; we found that it should be automated and smart to truly help.

During the winter quarter, three prototypes were built, each with a specific motivation in mind.

Influenced by our results from the CEP, we built the Dark Horse Prototype, more usefully known as “Trains, to investigate the question, ‘How might we directly inspire rapid design and ideation, and how far can we go)?. We built a simple toy train system to constantly introduce new prototyping materials to a team as they worked on a design prompt we provided. Through extensive user testing and surveys we learned that, ‘one persons inspiration is someone elses distraction – that an environmental stimulus that helps one person work more effectively will more than likely annoy another person and make the latter less effective. Furthermore, we also saw that owning a common goal – even one as simple as keeping a toy train on its tracks – helped teams of random strangers quickly band together and thus improve their design performance.

The next two prototypes specifically address two of the identified needs discovered during the needfinding phase. The first is the need for team ownership of the problem and design space. The second is the need for a process capture framework that helps teams be more conscious of the design process while easing the burden of keeping track of generated information.

The Funky System, more usefully called the ‘Venturoom, consists of Venture Branding, a team formation activity that teams entering Kungshall will go through, and the Verkroom, a smart room that automatically takes photographs of work done by the team and saves it to the teams Dropbox in a meaningful way.
Through Venturoom, we learned that automatically capturing work to the cloud, succinctly termed ‘Work-To-Cloud, is important and useful, but that users desire more structure and meaning than just tagged photographs. Importantly, we also learned that having a specific room to work in is very restricting – users want to Work-to-Cloud from everywhere. Finally, we also confirmed, albeit with just one test case, that a unifying brand identity helps to improve team spirit and motivation.

Our next prototype, the Functional System Prototype, sought to specifically address the discovered requirements from Verkroom. In order to Work-to-Cloud from anywhere, our system must be everywhere. Cognizant that work is usually done in either a horizontal format – on a table – or a vertical format – on a whiteboard – we decided that our product must be both. Thus we built ‘Verkholmen, a smart table that can be transformed into a whiteboard and vice-versa. We incorporated the features from Verkroom into Verkholmen, and added several software features, including design templates, meeting notes templates, and playback of old work.

Through user testing, we discovered that we had successfully preserved the physical experience of writing on a whiteboard – it felt natural to users in both table and board mode. The design was physically robust, and were a good height and size in both modes. However, because of the heft of the screen, transitioning between modes was deemed to be too difficult.

In terms of features, we quickly discovered that we needed a much more robust and reliable user interface, as well as a physical form that is WYSIWIG (What You See Is What You Get), so that users do not, for example, expect the screen to be touch-responsive. Furthermore, we saw that users wished to know what happened to these captured images – ‘where do they go, how will they help me?’

In parallel with the Venturoom and Verkholmen prototypes, and in response to the identified need of a process capture framework, we also conducted rapid prototyping and testing of Process Charting. Namely, we were trying to answer the question, “Can all of a design process be capture in a series of connected input/output blocks?” We envisioned that such a chart would allow users to ‘open up’ and analyze the design process, which is often seen by management as a sort of black box.

We first tried to capture our design process in this chart form. We then interviewed two ME310 teams and asked them to describe their design process, and used this information to see what elements would be needed in a Process Chart. We found that while most design activity can be well summarized by input/output blocks, some allowance must be made for external input, such as directives from upper management, or input from people outside the team. Furthermore, while input/output blocks are often a useful visualization, sometimes better ones are available in special situations – for example, a ‘pyramid’ is a great way to highlight three important factors. Finally, we also found that the very process of asking teams questions structured to help us chart their process in this way helped them to be more conscious of their design process.

In conclusion, we find that the physical/hardware solution of Verkholmen is more than worthy of further development. We believe that the main discovered requirement from user testing, of being able to record work with more structure and organization, will be answered by iterating and implementing Process Charting further.
4.0.2 Dark Horse Prototype

4.0.2.1 Motivation

“How might we directly inspire rapid design and ideation, and how far can we go?”

Inspired by the results of our CEP, where we learned that non-semantic ambient stimulus focused could help teams brainstorm better, and cognizant of our user interviews which showed that Swedish culture tends to favor detailed, long-term planning and replanning rather than rapid learning through prototyping, we decided to lunge at the idea of using environmental stimulus to directly encourage prototyping.

We envisioned a system that would encourage teams to prototype by constantly delivering new and unexpected materials and physical inspiration to them. This would be implemented in Kungshall as a series of ‘canals full of water that would carry prototyping materials from facilitators to teams, as well as between teams. Facilitators would be able to ‘DJ materials to send to certain teams. Old prototypes from both past and current teams would flow freely through this system, so that teams would inspire would another – it would be a social experience as well.

Figure 4.1: Sketch of the envisioned ‘Kungshall Canals’
Brainstorming ways to test this rapidly, we first decided on a motor-driven cable-car type system from which materials would hang off and move around a space. After prototyping, however, we quickly realized that for this system to work well a lot more engineering effort would be needed than was feasible.

Focusing on the fundamentals of the experience – the circulation of materials – rather than the ’wow factor, we decided to modify store-bought toy trains to carry materials in a loop on a table. Plastic Ziploc brand food storage containers were glued onto the trains, and wooden popsicle sticks were used to stabilize them from topping over due to the added mass.

### 4.0.2.3  Testing

After some preliminary testing in the Loft with other teams in ME310, we carried out two days of formal testing in the atrium of the d.School. We broadcast the testing through e-mail lists and offered cookies to participants for 10-15 minutes of their time. We chose this location because the majority of people who would enter the space and volunteer for testing would likely fall into one of the following groups which are close to our intended userbase: engineers in an undergraduate or graduate mechanical engineering program, students in a d.School course, or professional designers.

We set up two tables in the Atrium: the Control Table and the Experimental Table. The Control Table had prototyping materials scattered on its surface, but not moving. The Experimental Table had the moving trains setup cycling materials through the space.

We chose a varied selection of prototyping materials, most prominently: Lego pieces, cotton pieces, zip ties, modelling clay, some electronics materials, fluorescent fluffy wires, nuts, bolts, small pieces of coloured paper, small foam shapes.

We gave groups of 1-5 random volunteers a prompt to design a better toothbrush. The full text of the prompt can be found in the Appendix. The volunteers were asked to sit at either the Control Table or the Experimental Table and brainstorm, while we observed. If there was only 1 volunteer, one of our team members would participate in the discussion to help simulate a team brainstorming session. After the session was over, we interview them about their experience and also asked them to complete a survey that consisted of a few biographical questions, including age and occupation, as well as rating questions about several aspects of the efficacy of the prototype. A copy of the questionnaire is included in the Appendix.

We also conducted a few experiments with a variant of the Experimental Table where the train was moving without materials in it.

### 4.0.2.4  Results

**Bimodality**

The strongest and most prominent result, and also perhaps the most important, was that of bimodality – users tended to either love the trains, or hate it. Those who loved it said that the movement and sound of the trains helped set a rhythm and pace to the
brainstorm that helped move the discussion along, and that the noise helped to fill any awkward silences that could have sucked energy from the session. Those who hated said that the noise and movement were very distracting. Indeed, one could even observe this frustration – two test subjects were so frustrated that they picked up the train and turned it off! A few also asked us to turn it off.

This bimodality was also seen strongly in some aspects of the user survey, shown below.

It was interesting to note that the noise and movement of the train seemed to have a more pronounced effect on user reaction than the materials itself. The variant of the experimental table with just a moving train seemed to similarly either inspire or distract testers, although not enough test cases were run for there to be a strong result either way. Indeed, it is clear that any environmental stimulus used in our product should be customizable – lest we greatly annoy a subset of our users, rather than inspire them!

Looking at the biographical data, there seemed to be a fairly strong relation between professional designers and appreciating the movement and noise – those who most strongly disliked the noise tended to be administrative personnel or non-design engineering students. Thus, there seems to be potential that this could be a tool used to sort certain types of thinkers from others – a physical HBDI, of sorts.

Encouragement of Prototyping

It was observed that there was a fairly marked increase in speed and volume of conversation at the Experimental Table – both of which are probably attributable to the
movement and noise as remarked above. It was also observed that, while there was a marked increase in picking up of materials on the Experimental Table, there was only some increase in prototyping – indeed, most of the picked up material was used for fidgeting. There were some exceptional cases, where the ‘pressure to prototype caused by the circulating materials induced premature convergence and overfeatureing. A photograph of an overfeatured toothbrush is shown below – it has, to name but a few of them, automatic toothpaste dispensing, a flossing attachment, and a motorized brushing attachment. When interviewed, the creator of this prototype indicated that the materials speeding by proved to be too tempting and fun to play with, and she couldn’t resist. She also agrees that the toothbrush is overfeatured – she had started prototyping too early and when new ideas came to her later she just tacked them on.

Indeed, it seems that the goal of encouraging early prototyping needs to be refined to one of encouraging early meaningful prototyping. Furthermore, the movement and sound from the trains system had more of a marked influence than the materials themselves.

Unifying Behind a Common Goal

Most of the test subjects had never met each other before, let alone worked on a team together. However, when the train derailed – as it often did – they would co-operate to get the train back on its tracks, since it was very difficult to do this alone. After they did this, it was observed that they had more fluid interactions – some invisible social barrier
had been broken, and they were now a team. There was laughing and joking and general camaraderie regarding the constant need to watch and right the train. This improved team dynamics seemed to manifest itself in faster brainstorming.

Indeed, it seems that there is great value for improving team dynamics and bonding by owning a common task, even if it is one as simple and silly as fixing a toy train that constantly breaks down.

### 4.0.3 Venturoom

**Motivation**

When we interviewed users from Volvo, we found that they were often plucked from their various departments and blindly thrown into these innovation projects. They had no ownership of the problem space or of their own physical space – they often felt disenfranchised. They had often never worked on this project before, or with the people on their team. Furthermore, they tended to be located remotely and also be busy with their other daily responsibilities, and thus only had the opportunity to work together for an hour a week – and much of that hour would be spent reviewing what had happened the week before.

The Venturoom prototype was designed to address these needs in two distinct parts.
The first is the Venture Branding Activity, which teams go through when they enter Kungshall. Rather than being known as ‘Innovation Team 172 from Volvo, they meet with a facilitator and are rebranded as a small and agile start-up with a name and spirit of their own choosing. This is hoped to also contribute to a ‘special forces feeling as learned from benchmarking at SAP AppHaus.

The second is the Verkroom, a smart room which the team works in. It is designed to create a personalized experience, reduce the initialization time, and to help automate design process capture.

### 4.0.3.1 Design and Construction

**Venture Branding Activity**

The Venture Branding Activity was designed to be quick and rapid and ful of energy. The facilitator would help the team brainstorm a name and a motto that represented the spirit of their new entrepreneurial venture. We decided that physical paraphernalia, such
as ID cards and personalized lab safety glasses, and t-shirts, could help teams truly feel like a real small company. It sounds like small silly things - but we saw from The Trains that even something as small as righting a fallen toy train can help foster team bonding. At the same time, we wanted teams to get the feeling that someone else believed in their potential for success and was investing in their venture. In order to ease the workload on the team, and to prevent extended aesthetic discussion not directly related to the scope of their project, the facilitator would design the logo and produce the paraphernalia.

**Verkroom**

There was a screen, a whiteboard, a camera, and a computer system installed into the Verkroom. The experience of the Verkroom prototype started when the team used their ID card to tag into the room. It would instantly light up and become theirs. The screen would display an Enhanced Cloud Visualization of their shared Dropbox space, which showed pictures from their last brainstorm, as well as a branded ‘flower that represented the ‘health of the information stored on the server. Grey petals represented untagged files, while red petals represented tagged files.

Any work done on the board is captured and uploaded to Dropbox, when a user presses a button on the whiteboard eraser – when you pick up the eraser to clear something from the board, you would be reminded by the physical presence of the button to trigger it before erasing. As these pictures materialize on the server, petals would appear on their
flower. The goal of this is to transform the experience of adding new files from contributing to an overwhelming mess of information, to cultivating a beautiful, well-sorted, organically growing system.

![Image](image.jpg)

Figure 4.7: Tagging into the Verkroom with an RFID-equipped ID card causes it to instantly 'activate' for your group.

4.0.3.2 Testing

Venture Branding Activity

We saw a unique opportunity to test the Venture Branding Activity when one of our fellow 310 teams, Clariant, was going through a crisis similar to the experience the Volvo users went through. Their corporate sponsors had just told them they had to completely switch directions from chemical dyes to printed electronics. They felt unempowered and confused, and generally down in the dumps.

We made them the subject of our Venture Branding prototype. We brainstormed a name and a motto for their new entrepreneurial venture, and produced the logo and associated paraphernalia shown below. We presented it to them in a surprise ceremony, and observed and recorded the interaction. **Verkroom**

Because the teams in ME310 have already have a crowded Cloudspace, it would have been very time-consuming to setup a meaningful interaction between the physical Verkroom and the teams Cloudspace. To test the Verkroom, we walked a few teams through
the experience, showing them the various functions, and then interviewed them after. We also used the Verkroom for a few of our own design sessions.

### 4.0.3.3 Results

#### Venture Branding Activity

The Venture Branding Activity produced surprisingly strong results. Team Clariant, now renamed Patchduino, was happily surprised, and enjoyed their paraphernalia – they wear their team shirts in the Loft quite often. As can be plainly seen in this wonderfully heartwarming photo, it really energized them and raised their spirits. Importantly, it helped recast the arduous task ahead into an exciting adventure.

#### Verkroom - Work-To-Cloud

Testers felt that the automated photo-taking and the tagging was certainly useful, and could foresee it being helpful in their projects, but they wished for more meaning. They were excited by the proposed ideas that the flower could be restructured into a tree which contained more semantic information. Furthermore, they wished that the replayed photos could be played back on the same work surface, somehow.
Figure 4.9: A screenshot of the enhanced cloud information visualization. Petals are automatically added when photos are captured by the camera and uploaded to Dropbox.

In short, Work-To-Cloud in the form of automated phototaking of a whiteboard and tagging is a good start, users desire more structure and organization to the stored data.

Finally, users also strongly indicated that having to confine their work to just one whiteboard in one room was very limiting. They wanted to Work-To-Cloud from anywhere and everywhere that they had meetings.

4.0.4 Verkholmen

4.0.4.1 Motivation

Verkholmen (Swedish) = Work Island (English) The Verkholmen prototype was built to address two issues. The first is to address the discovered requirements from Verkroom, in particular the requirement to Work-To-Cloud from everywhere, and the requirement for more structure in design process capture.

The second is to consider the particulars of the Kungshall interior, taking into account the learnings about physical space from the needfinding and benchmarking phase. From our interviews with SAP AppHaus, IDEO, and Stpln, as well as the Make Space literature, we learned that teams function best when they have the ability to customize their space as needed. Although convenient from a packaging standpoint, restricting teams to work in a specific, fixed, room layout as in Verkroom is counter to this. We require a system
that allows flexibility of physical space.

Cognizant of the fact that there really are only two types of work surfaces, the horizontal table and the vertical whiteboard, we decided that our product needed to be both. In doing this, all work will be done on Verkholmens, and thus all work will be capture to the Cloud. Any work done on the board, be it hand-drawn block diagrams, Post-It notes from a brainstorming session, or the assembly of a physical prototype, is captured to the cloud.

We designed Verkholmen to have the ability to transition between table and board mode, and to be mobile. In this way, ‘fleets of Verkholmen can be gathered and rearranged to sculpt the physical space as needed. You can encircle a central horizontal workstation with a series of whiteboards, or arrange them in a line to explore a wide landscape of ideas.

4.0.4.2 Design and Construction

Protoprototype

The first hardware design iteration was piggybacked onto an old glass whiteboard prototype in the loft. We modified it with door and fence hardware from home depot to have the ability to transition between board mode and table mode by extending two extra legs from the top of the board. During construction the glass broke, and we replaced it with translucent acrylic. We integrated a picoprojector, the Acer C120, with a wide-angle lens attachment and a mirror. We experimented with using the raspberry Pi to drive the projector, but determined that it was too slow for the software to run smoothly.

Testing this quick prototype revealed three significant issues. Firstly, the picoprojector image was too dark to be useable in even fairly badly lit environments. Secondly, having
to pull the legs out as well as lower the board is an ungainly and inelegant way to bring the table down. Lastly, the vertical layout of board mode was too tall, and resulted in quite a lot of underused or unused area.

Prototype

The next iteration of the Verkholmen considered these shortcomings. Firstly, we designed a four-bar linkage to allow the transformation to occur in one smooth movement. The linkage was designed to center the table on the legs at a height of 39” at one end, and to center the top of the board on the legs at a height of 74” at the other. We found from quick benchmarking with existing tables and whiteboard that these were good ergonomic heights for both. What is the formal name of this linkage? I bet George wants to know.

Secondly, we integrated an LCD screen instead of a projector. Specifically, we used a Sharp Aquos LC42D62U which was found around the Loft. This allowed for much better picture quality in a variety of lighting conditions.

We used an HD webcam on a boom for image capture capabilities. A simple Logitech wireless touchpad (Model 910-002345) was used to capture user input. A laptop running Windows 7 was used to interface with these components.

The software written for Verkholmen is also browser-based, as in Verkroom. Because the screen is now also in the capture view of the camera, we had the opportunity to
show templates that could be written on with whiteboard marker and then captured. We implemented one specific manifestation of a template-based meeting structuring-and-capturing software.

The software is structured as a series of full-window ‘screens which the teams move between. We tested two different navigation options. In the first, users can move from one screen to the next by either swiping left, right, up, or down. This was found to be too unreliable, so we switched to using a left click, a right click, or a left+right click, which worked more reliably, albeit with less ‘wow factor. Every time the screen is changed, the work on the board is capture and stored on Dropbox.

When the team first starts the board, they are greeted with a screen that asks them, “What is the purpose of the meeting? Advancing to the next screen starts free-write mode: A white screen with nothing but navigation instructions. Users can either bring up a new white screen (right-click), and capturing the work that was done, go back to the previous filled-out screen (left-click), or finish the meeting (left+right click). When users choose to finish the meeting, they are asked to summarize what they learnt. Advancing from this screen (left+right click) stores this summary, and shows them a visual summary of the meeting, structure in Input, Work, and Output. The Input shows a capture of what was written in response to the “What is the purpose of the meeting?” prompt. The Output shows a capture of what was written as the meeting summary. The Work shows small versions of what was captured during free-write mode.

We also wrote a different instance of this software, a ‘Guide Me mode, where users could switch between a Needfinding template, a random inspiration mode, or free-write mode.

Figure 4.12: A photograph of the Verkholmen prototype in table mode.
4.0.4.3 Testing

Verkolmen was preliminarily tested in the 310 loft, where we quickly discovered that the swiping interface was unreliable. Switching to the clicking interface allowed us enough reliability to test with random volunteers in the d.School atrium. We simply asked them to interact with the board and simulate a brainstorm.

4.0.4.4 Results

Our prototype was successful at preserving the physical experience of using a whiteboard: observations and feedback from users indicated that they immediately felt comfortable writing on the board and did not feel that it had any significant drawbacks versus a normal whiteboard. We did have some other unexpected findings, though: the most surprising was how much users read into the form of the Verkolmen prototype. They were extremely sensitive to small physical cues - or things that they interpreted as intended physical cues - about the function of the technology and how they were supposed to interact with it. A few examples of expected features (and how we might manage these expectations in future prototypes) include:

- Touchscreen or other forms of screen interaction: Most likely because of the ubiquity of touchscreens in current technology, users expected a touchscreen or gesture-tracking system. Some also expected to be able to use their whiteboard markers to select items on the screen and click on links, and felt limited by being forced to use the touchpad. To keep
the cost of our system down, we do not plan on including a touchscreen, but are open to the possibility if further testing indicates that this is essential to the user experience. At the moment, we plan on managing user expectations by increasing the offset between the glass cover and the screen to make it obvious that the surface they touch has no connection to the screen behind it.

- Voice recognition: Probably because of the external appearance of the webcam, a handful of users expected the prototype to have voice recognition software and tried giving it verbal commands. We do not see a need to incorporate voice recognition at this time; we plan to manage expectations via the software by making it clearer how users should respond to the prompts provided in the template modules (the main cause of this misunderstanding was that the prompts felt too interactive, so users did not know how to respond to them)

- Range of image capture: Users assumed that the function of the work surface was limited to the screen they saw, and so were hesitant to write on other surfaces. They didn’t trust that the border areas of white outside the screen would be recorded, so were hesitant to write on them. This issue will be solved in future prototypes by having a larger screen, which we had planned on doing all along; the screen size on this prototype was limited by the TV that was available to us.

These expectations made us acutely aware of the issue of feature creep - our users will always demand more from our products, and it is Like all designers of smart products, we will have to make very strict decisions when defining what our product does and does not do, so we can focus our energy and excel at the functions we do choose to address.
4.0.5 Process Charting

Motivation
Flow diagrams are often used in engineering systems to succinctly describe the workings of a deterministic process. **Can the design process for a project, be capture in such a series of connected input/output blocks, and would that be useful?** We envisioned being able to zoom into different levels of detail in a design process. You start out with the view upper management usually sees: a proposed solution as the output of a black box simple called ‘Design’, whose input was the design prompt. If curious about other rejected solutions, unexplored paths, insights, or for more information about the work that was done, one can zoom in for more detail. Threads of thinking that run through the design process can be followed through the input/output blocks.

**Design and Construction**
To help teams diagnose their process, we invented four symbols that can terminate a thread:

- [?] *What happened to this thread of thinking? It hasn't been followed up*
  Often, in the excitement of a project, good ideas that clearly had merit do not get followed up on simply because a team forgot or had too many other more pressing
concerns. This is a way to keep track of these ideas; it is inspired by our team's 'forks in the road' wall where we keep a record of design directions that we have not fully explored but may want to later. It can be a great source of inspiration when teams get into a rut or feel that they need to branch out and explore new directions but do not feel particularly inspired.

- **[X]** *This thread of thinking has been terminated because of constraints*
  Some ideas simply are not feasible to carry forward - possibly because of resource, knowledge, or technology constraints, or because the project was not appropriate for the given prompt or partners. This does not mean, however, that the ideas are not worth recording - they could be picked up and carried forward by a team at another point. At the same time, it can be valuable to others going through a team's documentation to understand why ideas were dropped, so that they do not waste time pursuing dud project directions.

- **[-]** *This thread of thinking has been terminated because it is uninteresting*
  Sometimes a team simply loses enthusiasm for an idea. This tag is a way for teams to recognize this, communicate it to others, and move on so that they do not waste time carrying it forward.

- **[!]** *This thread of thinking is interesting and will be followed up*
  The most obvious tag - this is for the ideas which are most exciting and will be followed up on immediately.

Creating these charts demonstrated a number of advantages beyond those listed above, and we realized that process charting actually has the potential to influence a team’s decision-making process while it is happening. Adding intentionality to idea-killing pro-
cess could mean starting conversations that teams would not normally have. This may introduce more democracy to the process of idea-selection, as everyone gets the chance to voice their opinions when an idea is being shut down.

As mentioned above, process charting also made us realize that there are a number of external factors that need to be accounted for, such as ‘reality checks’ from experts and instructions given by sponsors and managers. These do not necessarily fit into the logical input/output flow, but they are important in a team’s process and need to be captured in some way. There are also essential pivot points that deserve recording - for instance, the appearance ground-breaking new technologies in the field.

At the same time, the process mapping made us realize the importance of filtering what gets recorded - in our discussions with Clariant and Edeka, discussion about interactions with their global partners repeatedly distracted them from telling the story of their design process. We recognize that tense team dynamics issues often seem far more important than static design ideas and prototypes, and it is hard to keep emotions out of a team’s process record; but this filtering is essential to keep the record concise, relevant, and share-able with the general public.
Figure 4.18: *Screenshot of the Meeting Start template.*

Figure 4.19: *Screenshot of the Free Write template.*
Figure 4.20: *Screenshot of the Meeting Summary template.*

Figure 4.21: *Verkholmen undergoing testing in the d.School atrium. Here, the user, Bruce Boyd, is navigating from one screen to the next.*
Figure 4.22: Verkholmen undergoing testing in the d.School atrium. Here, the user has just switched screens and is about to start writing on it.
Figure 4.23: The most zoomed-out view of the prototype Process Chart.
Figure 4.24: Opening up the Process by one zoom level, we can see the largely defined blocks of Benchmarking, Brainstorming, and Prototyping, and how they related to each other.
Figure 4.25: Going one level deeper, we can see individual Learnings and Needs from each of the process steps.
Figure 4.26: Finally, at the most zoomed-in view, we can see the detailed intricacies of one prototype.
Figure 4.27: Earlier explorations of how we might chart a team’s process, created during meetings with Clariant to try to simplify their account of the team’s process throughout the quarter. Certain symbols clearly start to emerge, representing different types of interventions that change a team’s direction; different ways that ideas converge or get killed; and different ways that ideas can connect to each other.
5 Design Description

5.1 Verkholmen

In designing the Verkholmen, we identified a few physical attributes that were critical to its core functionalities. Since the table can transform between horizontal and vertical modes it was important that its physical attributes in each mode supported the functionality. In the horizontal mode, we wanted to promote standing around the table surface, and hence the height was fixed at 40in. In the vertical mode it was important that the writing surface was between 3ft and 7ft as anything lower or higher would end up being unused. Being able to switch between these constrained configurations meant that a four-bar mechanism had to be designed to aid the transforming.

The support structure (base, legs and frame) for the Verkholmen was built using pine wood board with additional aluminum structural elements where needed. Standard lockable castor wheels are used on the base to assist easy movability of the unit. The writing surface on the frame is 1/8” clear acrylic that has been covered with a thin sheet of clear polycrylic to protect it from abrasion and help improve the writability on the surface. A white paper backing (that frames the display) was added behind the clear acrylic to improve the readability of markers on the surface.

The display surface on the Verkholmen is a 40” flat screen TV that is attached to the main frame using two Aluminum support bars. Image capture is done using a wide-angle lens webcam that is suspended 24” away from the screen so the entire writing surface is captured. The display and camera are controlled using a laptop. A touchpad connected to the laptop is used to navigate the display interface. The software interface is coded using Python and runs on the Web2Py framework through a browser.

An exploded view of the Verkholmen below shows the various components of the system. Also attached is a simple dimensional drawing of the Verkholmen.

<table>
<thead>
<tr>
<th>Component</th>
<th>Qty</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Wood Board</td>
<td>24ft</td>
<td>Home Depot</td>
</tr>
<tr>
<td>2” x 4” Pine Wood</td>
<td>5ft</td>
<td>Home Depot</td>
</tr>
<tr>
<td>1” x 1/4” Aluminum stock</td>
<td>4ft</td>
<td>Home Depot</td>
</tr>
<tr>
<td>3/4” square Aluminum tube</td>
<td>8ft</td>
<td>Home Depot</td>
</tr>
<tr>
<td>1/16” Aluminum U-stock</td>
<td>8ft</td>
<td>Home Depot</td>
</tr>
<tr>
<td>2in Wood Screws</td>
<td>10</td>
<td>Found in Loft</td>
</tr>
<tr>
<td>3/8” x 2” Bolts</td>
<td>10</td>
<td>Home Depot</td>
</tr>
<tr>
<td>Castor Wheels</td>
<td>4</td>
<td>Found in Loft</td>
</tr>
<tr>
<td>1/8” Clear Acrylic</td>
<td>56” x 42”</td>
<td>Tap Plastics</td>
</tr>
<tr>
<td>40” TV</td>
<td>1</td>
<td>Found in Loft</td>
</tr>
<tr>
<td>Wide Angle Webcam</td>
<td>1</td>
<td>Logitech</td>
</tr>
</tbody>
</table>

Table 5.1: Bill of Materials
Figure 5.1: Exploded view of the Verkholmen
Below is a figure showing the steps in the transformation of the table. The mechanism was designed to aid in elevating the table by 14", and is an inversion of a slider four-bar mechanism.

Figure 5.2: Transformation of the Table
6 Planning

6.1 Vision for EXPE

By EXPE in June, we expect to demonstrate the experience of a fleet of Verkholmen whiteboards. To do this, we will build at least two ‘smart’ whiteboards with integrated screens that can connect to each other and share a widescreen display across both. Depending on our final design choices, we will probably build at least one extra Verkholmen that does not have smart capabilities and simply demonstrate how a team could use the boards to physically block out other configurations in their workspace.

At this point, our design will need to be ready not only for production, but also for distribution - meaning that the physical form makes the user experience intuitive when there is no one present to give directions or control how users interact with the prototype. As discussed in the Verkholmen - findings section, creating a streamlined user experience will depend on the ability of the physical design to manage expectations of what the technology does, leaving no confusion or tension about what to expect from it.

6.2 Deliverables and Spring quarter prototyping plan

Our findings from our Verkholmen prototype helped us lay out our top priorities for our prototyping over spring quarter:

- **User experience design** So far, we have only developed skeleton software to sketch out the steps that the Verkholmen would guide a user through. To make the user experience smooth and intuitive, we will do quick rounds of prototyping at various levels - starting with paper and Wizard-of-Oz prototypes to define the requirements for the software. Once we have determined these requirements, we will make decisions regarding incorporating existing technologies (is there available software which we can use without sacrificing our vision?), and then tackle whatever coding remains by moving to layout mockups before coding and incorporating it into the physical model.

- **Software incorporation into the physical model** Once we have completed the software design, we will revisit the physical form to sync it with the software and ensure that it successfully manages user expectations of the software’s functionality. At this time, we will also refine some features to meet our identified physical requirements for weight, durability, and ease of use (see Verkholmen - findings and Physical requirements).

- **Extensive user testing to measure annoyance over time** One of the most serious potential pitfalls we’ve identified for our project is the risk of falling into the ‘Smartboard trap’: that is, creating technology that generates initial excitement, and is incredibly successful in theory, but ends up falling into disuse because the annoyance of using the technology exceeds the perceived benefit. The challenge here is that the ‘annoyance’ is so small that it seems insignificant to a designer, but the
accumulation over time makes it challenging even for users to say which direction they will fall in this tradeoff - whether they will come to see the annoyance as worth the benefit or not. The only solution we presently see to anticipate these use habits over time is to do extensive testing with the same group of people, leaving them with the Verkholmen on its own (and some recording mechanism) so they do not feel social pressure to use the board when they would not normally do so.

6.3 Milestones

The biggest milestone for Spring quarter will obviously be our final presentation for EXPE; but there are a couple of other key dates that other aspects of our project rely on. Starting April 15, we will have enough skeleton code for our software (i.e., a general idea of what it does) that we can start our next physical design around the software to help users understand how to use it. By this date, we will also need to decide whether we are hiring outside coders for the project. By April 22, our Swedish teammates will have finalized the process that we use in our software, so we will be able to incorporate it into our code.

The Gantt Chart in the figure below details how we plan to pace our work and coordinate with the Swedish team’s effort.
Figure 6.1: *Plan for spring quarter work*
### 6.4 Project Budget

**Winter Quarter: Resource Allocation**

<table>
<thead>
<tr>
<th>Mission</th>
<th>Time</th>
<th>Total $</th>
<th>Purchased Components</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dark Horse</strong> (Trains)</td>
<td>14 days (1/17 - 1/31)</td>
<td>110$</td>
<td>Trains + tracks&lt;br&gt;Prototyping materials&lt;br&gt;Incentives for user testing</td>
</tr>
<tr>
<td><strong>Funky System</strong> (Venturoom + Venture Identity)</td>
<td>14 days (1/31 - 2/14)</td>
<td>37$</td>
<td>Venture branding paraphernalia:&lt;br&gt;Technology for venturoom:&lt;br&gt;Ziggi camera: <em>Full quarter purchase</em>&lt;br&gt;RFID reader: <em>ME310 supplies</em>&lt;br&gt;Whiteboard, desk, TV: <em>ME310 supplies</em>&lt;br&gt;Wireless mouse: <em>Personal possessions</em>&lt;br&gt;Netbook computer: <em>Personal possessions</em>&lt;br&gt;LED light strip</td>
</tr>
<tr>
<td><strong>Functional System</strong> (Verkholmen)</td>
<td>21 days (2/14 - 2/28)</td>
<td>Protoprototype: $410&lt;br&gt;Prototype: $320</td>
<td>V1.0:&lt;br&gt;Glass whiteboard: <em>ME310 Supplies</em>&lt;br&gt;Pico projector&lt;br&gt;Raspberry Pi&lt;br&gt;Lenses and mirrors for Projector&lt;br&gt;Wireless touchpad&lt;br&gt;Hardware for frame&lt;br&gt;V1.1:&lt;br&gt;TV: <em>ME310 supplies</em>&lt;br&gt;Wireless mouse: <em>Personal possessions</em>&lt;br&gt;Laptop computer: <em>Personal possessions</em>&lt;br&gt;Acrylic for surface&lt;br&gt;Wood and hardware for frame&lt;br&gt;Tools for building</td>
</tr>
</tbody>
</table>
As summarized in the figure above, our spending in fall and winter quarters was relatively low, which leaves us with quite a bit of flexibility with regard to our prototyping budget in Spring quarter. This allows us the freedom to outsource some of our software development or manufacturing, and we plan to use this to take our project forward as quickly as possible over Spring quarter.

### 6.5 Distributed Team Management

Being that our Swedish team are PhD candidates with diverse backgrounds and experience with business and innovation modelling, they are taking the lead on the business aspects of the Kungshall center and designing the process that teams are walked through, as well as making decisions about how we will staff the space, etc. They will continue to play a consulting role in all other aspects of design development. The Stanford team will lead all prototyping and development efforts going forward. We will continue to interact and exchange notes through organized weekly meetings and will continue to use our blog as a continuous collaboration tool to exchange ideas and give feedback to each other.

### 6.6 Reflections and Goals

#### 6.6.1 Eva Hoffmann

Our team struggled a bit this quarter with scheduling issues and finding enough time to get everything done that we needed to. There were definitely times when the team’s energy felt low, due to other commitments or to lack of enthusiasm about our design direction (at the end of the Trains prototype, for instance), but overall we always managed to pull through and put in the work to make prototypes that met our standards. We will need to think very carefully about how we handle time management next quarter, because we have a lot of work to do and the level of work in ME310 notoriously ramps up in the Spring quarter. Our team has never done much strict planning of time and resources - we have always been able to strike a natural balance - but I think that this might be an important change for us to make as we move forward.

I think we could also make communication with our global partners smoother: while our relationship is strong and we have found ways to use our complimentary skill set for maximum efficiency, we’ve had trouble keeping current each other’s progress. Constantly updating and reading the blog is too much of a time sink for all of us, but our Skype calls are often plagued with technical troubles and miscommunication, killing productivity. There some solutions to this problem that might be worth exploring - limiting the calls to two ‘team liaisons’ that manage communications, implementing scrum-inspired communication, or finding better software to use for catching each other up.

#### 6.6.2 Aditya Rao

I have to say 2013 started a little slow. We were all coming back from our winter breaks (some of us having not gone to Sweden) and the last thing we wanted to think about was Kungshall. However, after building a ridiculously cute owl for P.Bots I think our excitement for the project was renewed. This quarter was rather cyclical in terms of the
teams energy but I think overall we had some critical breakthroughs with the project. I would like to say that we should be doing a better job with project management, but I think our system works and however unorganized we seem, we always pull through.

Personally, I am really happy we are building something tangible. I have fallen in love with the Verkholmen and have adopted it as my workspace in the loft. I am really excited going into spring because it involves more building (and hopefully some sanding!) As a team, I think we have a lot more to give to the project and I know we still have our best work left in us.

On a side note, not being able to go to Sweden due to Visa issues had me feeling rather low, but I have since forgiven the Norwegian Consulate. C’est la vie!

6.6.3 Jonathan Goh

This quarter began as the best of films do, with a vista of pure white, a Suprematist’s dream, a landscape of pure unadultered snow and rolling seas, punctured by a small jagged polygon of yellow in the distance. As we explored Sweden in our heavy hooded jackets, plodding through knee-high snow in a fevered hunt for startup incubators and white-maned serial entrepreneurs, this abstract shape solidified into concrete columns and wooden rafters – a fabled, storied space became real, tangible... touchable. Cold hands crawling finger over finger across three hundred year old brick, even colder toes wrinkling in wet socks. Sharing in shivering with new teammates, then communing over coffee and quiche buffet at Nya Skafferiet with fast friends. The history of Blekinge County in kitschy painted clay statues and shards of bronze arrowheads.

An SAS flight inbound from stoic Frankfurt, a Boeing 747 emblazoned with a bright blue streak, screeching to a halt in SFO, and then immediately we were running, breathlessly, after a Dark Horse. Almost no time to rest and reflect – some surpressed little voice in my head telling me that it was maybe far, far too little.

Thankfully a cloud of second guessing, third cousin of the Ghost of Christmas Past, descended upon our team and told us to stop, think, and reassess. From then on it was clear as day, full steam ahead, pedal to the metal, axe to the grind, a room and a camera and then a table which was, quantum mechanically, two things – and so much more – at once.

The dizziness of all this pivoting is just only beginning to wear off. Through a brief moment of clarity I can confidently say thus:

I am proud of what we have accomplished, and of the direction we have set for the quarter ahead. This was hard work, fraught with uncertainty and moments of deep doubt. But we made it through with heads held high. But even harder work lies ahead, and we will need to do what we have never done before – set a plan that looks further than three days ahead. There is also serious discussion to be had about the scope of this and the shape of that – let’s make sure we pick a lagom scale of project, so we have the time to make it absurdly beautiful, relentlessly refined – something we can be truly proud of.
Bibliography


Appendix A

Notes from December 2012
Sweden trip

Interview with Peter Wallin
Peter Wallin is the Innovation Portfolio Manager for Volvo Construction Equipment in Sweden. We had the chance to sit down with him briefly and discuss how he might make use of a space like Kungshall, what his top priorities for innovation projects are, and what he feels is missing from the innovation culture at Volvo. Below are some relevant excerpts from our interview notes.

What is the structure for proposing and implementing innovation projects at Volvo?

Technology working groups (TWG’s) create the ideas that go into their innovation portfolio, and then his responsibility is to sort through and prioritize these. Kungshall would probably come even before these, to come up with the kernels for innovative ideas.

- Each tech working group: 4-5 ppl, incl. 1 technology planning manager (director of the area) + 1 specialist
- Working groups produce Technology area plans but these aren’t usually for radical innovations, just focusing on incremental improvements over what they currently have

What prompts would you send a team to Kungshall with?
He’d prefer to send them with a challenge to address rather than with an idea - being forced to work with an idea is too limiting for creativity. Setting a target of 10 Most important results he wants to see from Kungshall?
Key focus = providing value to the customer; we need to demonstrate the value that we’d add.

Biggest challenges to using Kungshall?
• Scheduling - getting people to take an entire week off. Most important to the success of Kungshall is getting the right people to go.
• Scheduling is always a problem for TWG - can’t meet that often, and when they do it’s not always efficient. Ideal would be to find a way to make their 10 1-hour meetings over the course of the year act as one day-long meeting, but that’s just not really possible. Spend so much time just trying to figure out when to meet.

How would you measure the competency of a place like Kungshall?

• Trial phase, looking at how it worked out for other companies
• Ability to work with other teams and network outside of Volvo (He is fine with competitors using the same space - just sign an NDA or something beforehand)
• Measure competence of staff based mostly on personal relations

Meeting with Mikael Blomqvist

Mikael Blomqvist, our corporate partner and the founder of the investment firm Michano AB, is interested in stimulating innovation in the Blekinge region. In our first meeting with him, we were able to get his vision for Kungshall, his opinions on what makes innovation in Sweden - and specifically in Karlskrona - unique, and how he would define success for the project. What are your main goals for the Kungshall product?

Creating a culture of making’ in the area. Make something happen - stimulate growth in his home region. BTH has done a lot to help this. This region has always been really strong in manufacturing.

What about the Swedish environment is unique for entrepreneurship?
Production and software - Ericsson, Spotify - different than Silicon Valley because people are more easygoing, and there is more hierarchy. Companies in general will grow stiff and die if they don’t reinvent themselves, and Swedish are really great at reinventing (but it’s a struggle to even convince a lot of companies that they are too rigid and need to evolve). Export has always been essential to the economy, so it’s something that they do well/have a great infrastructure for - and anything we do needs to have a global focus - has to be scalable and can’t be cloistered in Sweden. Other initiatives in Sweden are not thinking large-scale enough. He wants to create connections between Lund, Copenhagen, and Gothenburg - and then to the world.

How does ALMI play into the equation?
It’s just not on the scale that we are capable of - they’re too local, can’t make a $6m investment at the drop of a hat. Not having that flexibility can really harm companies. ALMI is good for some investments - it’s easy money to get, and you can’t lose too much. For larger investments it’s important to discriminate much more.

"If you don’t lose anything, then you haven’t tried” How does investment here compare
to Silicon Valley venture capital?

He wants to import the SV attitude, but only parts of it and in a very structured way. Swedish are calm and considered, rather than aggressive elevator pitches. In SV, people tend to lose interest so quickly, so it’s necessary to be that aggressive. This attitude does not work in Sweden. *Is there anything you wish you could offer the companies you’ve funded that you haven’t been able to?*

Honestly, no - the biggest challenge is just to find companies that are worth investing in. Hard to push people into the global mindset and to think on bigger scale - most Swedish want to make their daily bread and not more.

*Main goal =* to make the d.school in a more European way, on a global basis. Wouldn’t want teams to come here to go through a fixed set of steps - too structured. He’s expecting to attract people here to spend an entire year in Karlskrona. This should be the first of many - wants to see more of these built over time.

*What’s unique about Karlskrona?*

Politicians aren’t thinking big enough here, and he wants to change that. Karlskrona’s not that big, you can always fix things. Really strong sense of equality here that he really likes.
Appendix B

Fall Quarter - Space Benchmarking Visit Notes

IDEO, Palo Alto - Andy Switky

- Focus on the creativity that happens between functional spaces: this is an issue that keeps coming up. Don’t underestimate the importance of collaboration that happens through accidental meetings, etc.
- They have no definite or simple method for process capture - everyone is responsible for recording their own brainstorming sessions, etc, and Andy was doing it by taking photos on his phone. Anything about the process they want to save just gets stored in file boxes or on their server; so documentation varies dramatically from designer to designer. We see a huge opportunity here.
- Presentations are a huge focus for them, because their clients are paying a ton of money for these services; they really believe in making these flawless. The try to make them look simple and clean but it actually takes a ton of work to do this.
- When asked whether new clients seem overwhelmed by their space/process, he emphasized the importance of having newcomers go through the design process once and experience the satisfaction that comes with the 'wrap-up' at the end of a cycle, where all of a sudden, the ideas that seemed crazy get pulled back together into something exciting and innovative. Formalizing this process will be really important for communicating to funders or to the large companies which satellite teams come from.
- Importance of having a common language between different offices - anywhere you go in the world, you’ll have these little baskets of sharpies and post-its available throughout the office. This is super important to support creativity anywhere, and is nice as a connection between offices in really different cultures.

SAP AppHaus, Mountain View - Philipp Skogstad
His key requirements for AppHaus space:

- Multidisciplinary, top notch, co-located people (co-location essential to move fast enough on their projects, arrange meetings etc.)
• Extremely short design cycles (he started AppHaus because needed to design something in 90 days and couldn’t achieve this at slow-moving large company (he calls this "oil-tanker" corporate culture); especially important that everyone is physically close to make things move faster.
• Support the people and the process (space needs to be FLEXIBLE, EVOLVING, and INSPIRING)
• Space needs to ‘give permission’, so people not afraid to mess it up and take ownership (team defines their own space) - he achieves this by looking unfinished

Challenging questions for us to address:

• How will we build a persistent culture, and make people feel truly engaged and responsible for the space, if we have a high turnaround? In general, if teams are rotating, their efforts may be more halfhearted because they feel that everything is only temporary.
• Consider HPI - teleboard for remote collaboration benchmarking - whiteboard+skype+recording - but the technology is a little complicated and for this to be feasible you’d need a devoted tech person. Who wants to put in that much effort/should you really have to?
• Key to AppHaus has been letting things go, allowing the space to grow organically (really hard for some cultures, especially Germans who like to plan).
• AppHaus works because it achieves the 'special forces' feeling on a team, making them perform a lot better. They need a sense of contrast between where they normally work and our 'special forces team' space.
• Importance of Kungshall coaches having a stake in the teams success: 'design services team' did coaching for SAP teams around the world but never worked out very well; teams saw them as outsiders, low engagement. (Opportunity here: can the space act as a coach that subtly pushes teams in a direction? With coach, teams will ‘nod-and-ignore’, but space might have a unique advantage if ‘pushes’ are subtle enough...)
• One key for our space is peer learning. We should take advantage of shared space, and teams with seemingly unrelated projects may have a lot to learn from eachother. Should be able to see/hear into other teams’ spaces. (But: need to think carefully about privacy/IP issues with both startups and corporate teams - maybe make the entire space subject to non-disclosure agreement? Or everything open source?}

Wallenberg Hall, Stanford - Robert Smith

• Tools like Copycat for auto-documentation of brainstorming sessions are just not working. Not transparent and a lot if people feel it is not worth investing the time to learn. Either need technologies that are ultra simple and approachable or else need some guarantee that they will stay the same over time (or, need it to be so widespread) that investment to learn them now is worth it.
• We need to be careful not to cloister the technology we develop in Karlskrona - how will we make this a truly international place? Or go for the other extreme - pitch this as a retreat really away from all distraction. But then be aware that people won’t be staying here for long.
• It’s important that people don’t worry they’ll break the technology in the space, especially in Sweden where people tend to be a lot more polite. (Or if they do break it - that’s good! We want to know what went wrong to create better technology!)
• Our space may want to have ‘design practitioners’/gurus who are always there, and responsible for being constantly ‘meta’ like an IDEO deep dive team that is always around to help people out.
• Making people happy/comfortable/unthreatened is far more important than technology - do this and then all that’s important is basic technology to support them.
• Potential for technology to make teamwork more democratic/avoid having one leader. They arrange setups with multiple screens so everyone works simultaneously, and find that the students are much more engaged if they are simultaneously doing tasks related to the teacher’s task.
• It is crucial to have a space that will adjust to future technology - cable trays in Wallenberg mean it’s really easy to rewire everything when new technology comes in. Otherwise building gets outdated when the tech does.
• Importance of having teams learn from each other. The teachers in Wallenberg benefit a ton from learning how other teachers have incorporated technology into their classes. Maybe we should consider designing an apprenticeship program where students or entrepreneurs can work with a company’s satellite team and learn from them.

Neeraj Sonalkar, Stanford Design Group PhD Graduate

• There has been a lot of research into concept generation patterns, and a lot of research into designers’ interpersonal behaviors on teams, but very little research connecting the two.
• The traditional idea, both in improv and in design, is that ‘blocking’ behaviors on teams are necessarily bad. But this is not necessarily true; it is much more important to look at how other teammates negotiate blocks. What differentiates good versus bad teams is not the existence of blocking behaviors, but rather how they negotiate those blocks. Maybe rather than influencing how teams interact overall, we should focus on training members to negotiate blocks better.
• Responding to a question about giving teams feedback - during his PhD research, he wasn’t giving feedback, but does do that in his current work and a lot of teams respond well. He hasn’t tried negative feedback yet about their behaviors, though - only encouragement, and intervening in situations where he sees that something’s not working. It’s awkward at first, but he got used to doing it quite fast.
• Improv theater is a great place to get inspiration for design team dynamics in general - deals with the same question of what do you do in a space of not knowing, where the only option is to build on team members until you collaboratively find a direction for the team to move.
• Being aware that these dynamics exist is enough to change the way people interact on teams - his researchers feel this in their own work. Maybe we should consider sensitivity training for incoming teams?

Volvo Construction Equipment - Jenny Elfsberg interview by Mikael Johnsson, Munktell Science Park
Requirement/Demands: What requires would you have on Kungshall if they say they have an creative environment?

- Freedom to do whatever is needed on site.
- The less predefined the better for creativity, maybe an empty white space with hidden resources that could be used when they are needed.
- Easy to see what’s going on in a nearby industry, being a place in the reality or very good Internet connection.

What competences would you require on site?

- The character of a multifunctional/multidisciplinary group.
- A process you can trust on, that handles chaos.

What requires would you have on the environment?

- Have to be a relaxed place. Ordinary meeting rooms kill creativity. Tables, if needed, should be round.

Positive approach: What would motivate you to send an iGroup to Kungshall?

- If I knew there could be there, being focused on the tasks.
- Resources on site
- Processes and process managers. A person who can guide a group in a systematic way where chaos is OK.
- From sketch to demonstrator which could be made of clay or a virtual model

What offers would you expect from Kungshall?

- The facility by itself.
- The facility + process.
- Educating of process.
- Annual conference on creativity.

Delivery: What would you expect an iGroup to bring back from Kungshall?

- Education = i, competence
- Concept (might take a few times) = i, concept descriptions, illustrations

Can you imagine VCE to visit Kungshall to get conceptualization in terms of illustrations and models if the total time was 1 week? Yes, it doesn’t need to be a working prototype, model that explains functions would be good.

Approx. how much would you spend on a week like that? 200,000 SEK

Can you imagine VCE to visit Kungshall to develop a prototype (pre-stage to production development) of e.g. steering device if the total time was 2 month? Yes

Approx. how much would you spend on two month like that? 1,000,000SEK

Can you imagine VCE to gather a strategic team and visit Kungshall in purpose to conceptualize strategic directions during a time of one week? Yes

Approx. how much would you spend on a week? 200,000SEK on product level
1,000,000SEK on company level if material can be used for marketing.

Negative approach:
• What problems do you see by sending an iGroup to Kungshall?
• Many would react on the remote location. Sweden is not the center of the world and Karlskrona in in the middle of nowhere.
• Make sure that you get something out of it. Specifications maybe
• Companies like VCE are driven by annual reports, events that doesn’t have obvious benefits for the company will be cut off.
• Explicit that it’s not just for fun to visit Kungshall

*What would make you to not recommend Kungshall to someone?*

• If the concept were to unclear. I like innovative product development but not reports.
• Not so into team building events.
• Paper products like McKinsey proposing ‘changes’ are of no value.
• If I’ve tried if a couple of times and doesn’t get any concrete I’d be unhappy.

*Except for VCE, what other companies would you expect to see at Kungshall?*

• Would like to see telecom, healthcare. Completley different from VCE.
• I would like to learn from others than our selves, we are moving from products towards services so we have a lot to learn.
• I wouldn’t be afraid of competitors.

*What would make you recommend Kungshall to someone?*

• Imagine to send an iGroup where they work according to a process, the Raft-model maybe, and after a weak they can present something. It doesn’t have to be a business case but they come back full of energy. I’d love that and it would be so important for the members in the iGroup.

*How did you find the questions?*

• Good, and it was fun

*Is there something you’d like to add?* It has to be a international feeling. VCE wouldn’t be very interested if it’s not. I can compare of my situation of going to Brussels when I have to present something.
Appendix C

Brochures from SGM
Presentations
THE KUNGSHALL CANALS: A Dark Horse Prototype
ME310/Team Kungshall/Jan 31 2013

The Focus
We envisioned our dark horse to be a space that has a constant stream/flow of material (prototyping) through it, thus creating a constantly changing environment. We were interested in understanding how users responded to the stimulus, particularly in observing any behavioral shift in their approach to prototyping.

The Idea
Create an elaborate system of canals in Kungshall that would constantly circulate material (prototyping resources, inspiration, failed prototypes and in some cases people) in the building.

We quickly distilled our idea down to its critical experience of ‘moving material’ and implemented it by putting together a toy train system that carried a variety of prototyping material around a table. Users were then asked to participate in a simple team design exercise on the table.

The Motivation
Prototyping at a low resolution (or any resolution) is critical for moving the design process forward, so we wanted to lower the barrier of entry to prototyping and get teams to prototype faster and more frequently.

We also saw an opportunity in the constant change in environment to randomly inspire teams. Easy access to material to fiddle with makes it easy for users to keep their hands busy, further increasing the level of movement and activity in a group.

The Darkness
We saw this as a dark horse for a number of reasons. First, it was a completely new direction for us in the project, one that is mostly unrelated to all of the work we have done thus far. The idea seemed crazy because it could easily be distracting, gimmicky, difficult to maintain, and challenging to stock the correct materials that would feel relevant for all the teams in the space. It could lead to other, even more radical aspects, such as having a ‘DJ’ controlling and ‘mixing’ the streams of materials.

To actually build and maintain a system of indoor canals would be hugely expensive, and would certainly create a sense of awe -- but how useful would it be?

An example of premature prototyping: A toothbrush with too many features and doodads. The creator felt that the trains 'pressured' her into prototyping too early on.
User Testing: Survey Results

**Either small effect or strongly bimodal effect** (Number of surveys = 20)

User Testing: Discoveries and Takeaways

<table>
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<tr>
<th>Expected Outcomes</th>
<th>Unexpected Discoveries</th>
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| **Lowering Prototyping Barrier** | Constant stream of materials should make people prototype sooner | Start building sooner  
More flexibility in team direction?  
Less considerate, premature  
Not necessarily MORE prototyping |
| **Group Dynamics** | Movement on table should encourage movement in group | Faster pace  
Less attachment to ideas generated ... and less investment overall |
| **Personal Reactions** | People can be energized by movement, regardless of materials | Noise fills awkward silences  
Working together to keep trains on track: build community/break the ice  
Stimulating *(for those comfortable with chaos)*  
Disturbing/distressing *(for some)*  
Felt more engaged, regardless of how they actually acted |
| **Engagement Level** | (did not consider this) |  |

*Potential paths forward:* Leverage the disruption of starting/stopping to manipulate team direction  
Build sense of community - have team united by multi-person task  
Opportunity for reframing; use trains as a tool to gauge personality types
**KUNGSHALL**  funky system prototype

<table>
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<th>user</th>
<th>needs...</th>
<th>because</th>
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| An inter-departmental satellite team from Volvo entering this unfamiliar space (environment and physical) | - **team unity**: To bond amongst themselves and have a clear sense of purpose  
- **space persistence**: To feel at home (comfortable and efficient) in the space - shouldn’t worry about losing their work when they leave the space  
- **information management**: To record their process, communicate their achievements, and stay in touch with Volvo HQ | they are tasked with delivering innovation on a very tight turnaround time. The tech in the space should support their creativity so they are not bogged down by details. |

**solution**

- Help large companies move like small companies through a *launch your venture* activity. Simultaneously give them the freedom to define their own goals and the unity that comes from agreeing what these goals should be. Cement this identity and foster a ‘special forces’ feeling through a **branding** activity with team gear.

- Give the team ownership of the space by defining their ambient conditions (lighting settings) and by preserving their work via multimedia on a website. This saves time by eliminating the time to ‘initialize’ team space/recall train of thought from past conversations.

- Create **personalized persistent cloudspace** that is linked to the team’s physical workspace, preserving the idea development process and helping to organize, summarize, and present concepts that are developed.
<table>
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<th>built...</th>
<th>learned...</th>
<th>future/past...</th>
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<tbody>
<tr>
<td>Clariant rebranding CEP</td>
<td>+ Emotional response far more powerful than expected</td>
<td>- Extend team feeling beyond cool paraphernalia customize space further than info display to make it feel more personal/relevant</td>
</tr>
</tbody>
</table>
| d.flower = Visual communication of information health | **As info grows, you should feel proud, not intimidated**  
- Display should be kept relevant to the purpose (/payoff) of tagging  
- Lag in system makes flower feel disconnected | **Positive reinforcement** from ambient abstract stimuli  
- Needs to represent the connection between act of tagging and payoff (organization)  
  - ‘Tree’ indicates branches that feel obscure and harder to access if not tagged  
  - Display more information elucidating the connection between graphic+info - write the tags/topics?  
- Need immediate gratification/feedback  
- Create more pleasant UX, ways to tag as you work |
| Eraser = camera trigger | + Feels good to click to advance (sense of achievement) | - Consider smart sensing, but preserve the physical experience |
| Archives display | - Need some persistent information | Suggests relevant ‘experts’ within Volvo?  
Some way of presenting team process; summary video  
How this communicates to boss - should Volvo have access to all information? |
| Overall experience of (physical) space | Helped us define the **bare minimum of tech support** needed in a space | - Incorporate this bare-bones technology into fun spaces  
- Achieve **special forces** feeling with room, not just rebranding gear  
- Incorporate **movement and energy** from CEP/Dark Horse |
WHAT WE DID

How can we make people more conscientious about their design process? For newcomers, this means teaching the design process; for more experienced designers we focused on how to improve team dynamics, raise intentionality, and discuss common goals.

HARDWARE:

The whiteboard system includes:
- vertical (presentation) or horizontal (table) mode
- screen behind whiteboard, controlled with trackpad
- webcam to capture team’s writing on the board and store it in cloudbase

SOFTWARE:

Four ‘modes’ that the user can choose between:

INSPIRE ME: Abstract ambient stimuli to energize a team; users choose a ‘mood’.
GUIDE ME: Templates to teach the design process, define goals, and structure documentation.
REMINDE ME: Teams can pick up where they left off at last meeting, and search their history.
IGNORE ME: An essential feature is that it can be used as a normal whiteboard when ‘off’.

TEAM PROCESS MAPPING:

Led discussions with Clariant and Edeka, to map out their team’s progress this quarter. Can every design process be captured in an input and output box? How to identify the major parts of a team’s process? Can a structure help them recall and express it?

WHAT WE LEARNED:

Prototype 1
- Hardware: Picoprojector not bright enough. Hard to have good projection quality.
- Software: Raspberry pi is slow, especially for web-based app.
- Tableware: Extending legs is clunky, robustness is paramount for usability! Glass shatters.
Prototype 2:

WHAT WE LEARNED:

Electronics: Screen works really well, even in bright light. People seem more engaged but this might be initial excitement.

Tableware: Four-bar linkage works well for setting right table and board heights.

UI: Simple swiping was not robust; left/right click works well. Users always want more input modes (touchscreen, speaking).

- Camera: Users like the ability to capture prototypes and post-its. Users want to write over old work.

- Meeting Structuring: Works well the first time, but users quickly start to ignore prompt — need to incentivize writing goals (through mapping?).

Image review: Users expect the board to erase when you change screen.

NEXT STEPS:

Electronics: Lighter screen would be great!

Tableware: Need physical indicators of how to transform table. Transforming table should require less strength.

UI: Must be robust or users will stop trusting it. Users are intrinsically explorative - how can we use this to manage expectations, and smoothen learning curve?

Camera: Needs to be smarter about not taking photos of the screen (flash white?) and synthesizing. Really important to be able to overwrite old work. Needs higher resolution and better alignment.

Meeting structuring: Summary page needs to be interactive.

Image review: Need clearer indication of where the info goes.

Overall: Users want and expect more - they demand a whole ecosystem.

TEAM PROCESS MAPPING:

- Must allow for external influences that just have an output box (‘disturbances’ such as reality checks from discussions with experts, direction from sponsors).
- Meditative value of recapping team process: they struggled to find structure for summarizing their work, but talking through it made them more conscious about their decisions.
VISION FOR EXPERIENCE

Build a streamlined physical experience and simple intuitive UI that uses the physical appearance of the board to set up expectations for how to use it. Multiple boards to prototype the interaction between a ‘fleet’ of whiteboards that talk to each other, and to cloud (we need to define exactly what they ‘say’)

PRIORITIES FOR SPRING QUARTER DEVELOPMENT

- Spring break: test simple version with innovation groups
- Rapid software iteration - serious testing of UI. Making it intuitive (extensive paper prototyping)
- What do you expect it to do (touchscreen)? What do you want it to do? How does physical experience manage expectations?
- More refined capture - how we process and convert to text
- Cloud storage decision: web interface or use local host? Incorporate smartphones?

[ outside our scope: Optics/camera (CopyCat); the process that our board guides teams through (Swedes); reduced emphasis on tagging to focus more on defining goals and outputs. ]
To help teams embark on a radical design voyage, we welcome them to Kungshall with a Venture Branding Activity -- in this space, they shed the shackles of being a team within a large corporation, and are instead a lean and agile start-up, imbued with a name and spirit of their choosing.

When teams return home, although this physical space is left behind, this Cloud Workspace remains the backbone of their project. In this way, the entrepreneurial spirit and rapid workflow developed at Kungshall endures.

**KUNGSHALL**

**OUR VISION**

A creative ecosystem to encourage meaningful & radical collaboration, anchored at a new innovation center in Sweden.

1. Teams are surrounded by a fleet of enhanced whiteboards that can be gathered as needed, moved and reconfigured -- even turned into tables -- to shape the space as they want, when they want. Any work teams do on the boards, be it written, post-it, or digital, is automatically stored and logged in their Cloud Workspace.

2. In this way, the evolution of ideas is automatically charted as a series of connected meetings, and can be browsed as needed. The chart allows bosses to peer into the inner workings of the design process, and extract useful learnings and insights that might be otherwise lost at sea.

3. To help teams embark on a radical design voyage, we welcome them to Kungshall with a Venture Branding Activity -- in this space, they shed the shackles of being a team within a large corporation, and are instead a lean and agile start-up, imbued with a name and spirit of their choosing.

4. When teams return home, although this physical space is left behind, this Cloud Workspace remains the backbone of their project. In this way, the entrepreneurial spirit and rapid workflow developed at Kungshall endures.
BACKGROUND

Kungshall, in the coastal town of Karlskrona, Sweden, was built in 1787 as a naval warehouse. Now, Volvo CE and Michano AB -- the former the very definition of a traditionally big company, and the latter the investment arm of the firebrand serial entrepreneur Mikael Blomquist -- want to turn it into a radically new innovation center that combines the best of both their worlds.

Teams from large, slow-moving companies that are tasked with delivering innovation on a short timeline face a stressful process: even if they come up with a great idea, communicating the value of the work they’ve done can be difficult. Employees have trouble focusing because these projects are only a small part of a portfolio of work they’re doing, and innovation projects often get overlooked to prioritize more immediate work concerns as they arise.

Innovation teams need flexible creative support that can help them focus; and the tools to make them as productive as possible, whether they’re away for a week-long creative retreat, or can only work on these projects for a few scattered hours or days. An essential part of this is finding a way to maintain quick access to the information they’ve generated, in a condensed and organized format.

DESIGN REQUIREMENTS

Low barrier to use: Our boards always also function as basic whiteboards and preserve the physical experience of writing with a marker. Any added smart features must be intuitive.

Pushes teams out of their comfort zone: We’ll force teams to explore new creative spaces together; this can be by reconfiguring their physical environment or through inspiration introduced by the board itself.

Improves design process conscientiousness: For novice designers, this means teaching the design process, while for more experienced users the focus is on helping them more consistently document their process.

DESIGN DEVELOPMENT

MOVING ENVIRONMENT PROTOTYPE

Introducing motion into a team’s space has a surprisingly strong influence on designers, but it can be both energizing and frustrating.

January February March April May June

ENHANCED WHITEBOARD PROTOTYPE

Users demand more from collaboration tools than just writing surfaces or touchscreens: they expect a larger ecosystem of integrated design tools. But these tools must stay specific to be useful.

MOVING FORWARD

Extensive user testing will help us polish the software user experience. We’ll develop a physical product around our desired experience that sets expectations for use and generates excitement and energy for the design process.

PERSONALIZED TEAM SPACE PROTOTYPE

Creating a personalized team identity and a place that the team feels is their own can profoundly influence team dynamics.
Appendix D

Extra Materials from Trains Prototype

For our Trains (Dark Horse) Prototype, users were given the following prompt:

*The electric toothbrush is an ubiquitous yet complex product that has to combine superb ergonomics and innovative mechanical systems in a user-friendly package. What could the next great electric toothbrush look like, and what would it do?*

After completing the tasks under a number of conditions (trains on, trains off, trains turned on in the middle of the brainstorming session, etc.) they were asked to complete the following survey.
Age:

Profession/Major:

Design Experience (Check all that apply):
O Not interested in design whatsoever
O Interested in design, follow design trends
O Hobbyist - do electronics, crafts, woodworking, building things, art for fun
O Studying or practicing something related to design
O Other:

I tend to communicate ideas through (Check all that apply):
O Talking
O Writing
O Drawing
O Gestures
O Digital Media
O Physical Objects
O Other:

I tend to understand ideas best through (Check all that apply):
O Listening
O Reading
O Gestures
O Sketches
O Digital Media
O Physical Objects
O Other:

When I am in a team, I am most comfortable being the (Check all that apply):
O Leader
O Planner
O Thinker
O Builder
O Other:

When the trains are running, how did it make you feel?:

**Excited:**

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<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
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</table>
1: Made me more bored 10: Made me very pumped

**Stressed:**

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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>
1: Was too relaxing 10: Made me very stressed
**Overall, did you feel that the materials:**

<table>
<thead>
<tr>
<th>Helped the discussion:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Greatly hindered the discussion</td>
<td>10: Greatly helped the discussion</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Were easy to pick up and use:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Too difficult to pick-up, prevented me from doing so</td>
<td>10: Very easy to pick up and use</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Were easy to put back:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Too difficult to put back, prevented me from doing so</td>
<td>10: Very easy to put back</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Was useful for physical visualization:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Not useful at all</td>
<td>10: Very useful for physical visualization</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inspired our brainstorming:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Too distracting from conversation</td>
<td>10: Provided interesting source of inspiration</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Other Thoughts:**
Appendix E

Fall Quarter Prototyping: Experience and Functional Prototypes

E.1 Critical Function and Critical Experience Prototypes (CFP/CEP)

E.1.1 Scrolling Whiteboard CFP Development

Site visits to design spaces revealed that augmented documentation technologies such as SmartBoards, and meeting capture software such as Quinid, are rarely used: although they create great value, they interfere too much with the simple, intuitive, physical experience of simply writing on a whiteboard. It seems that because this value is assessed at a later time, when you actually need to recall the information (such as the author’s present predicament), in order to encourage use it is more important to minimize the degradation of the physical experience than to greatly enhance the value of the documentation. So we are concerned with making the ratio:

\[
\frac{\Delta Value}{\Delta Annoyance} \gg 1 \quad (E.1)
\]

In creating this CFP, we wanted to address the motivating question: *Can we create a useful automatic, digital documentation system without degrading the physical experience?* We also saw the opportunity to push it one step further, and ask: *Can we enhance the physical experience of writing on a whiteboard?*

The team does our brainstorming on a table with a plastic dry-erase surface, which we find to be very useful. During brainstorming about possible automatic documentation paths, we became frustrated about running out of space and having to stop, take a picture, and then erase the board. We realized that this frustration was itself a needfinding nugget, and this led to the wish, ‘I wish we had infinite whiteboard space!’. The team collectively became very excited about the idea of a ‘scrolling whiteboard’: after a series of ‘Yes And’ moments, in which interesting features of other ideas were synthesized into the Scrolling Table, a rough sketch of physical and functional requirements was created, as shown in Tables E.1 and E.2.
Table E.1: Physical Requirements for Scrolling Table CFP

The prototype was built by combining an IKEA table with a 24’ roll of Go-Write Dry Erase surface, and a digital camera in a lightbox. A picture of the table shown in Figure E.1; a picture of it in use is shown in Figure E.2 More details can be found in ??.
E.1. Critical Function and Critical Experience Prototypes (CFP/CEP)

Figure E.2: Photograph of Scrolling Table CFP in use

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Metric</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing on the scrolling table should be intuitive, and feel the same as writing on a whiteboard.</td>
<td>There should be zero learning or adjustment curve for someone who is familiar with writing on whiteboards</td>
<td>Minimize annoyance</td>
</tr>
<tr>
<td>Scrolling action should be intuitive</td>
<td>Should be able to look at table and discern functionality</td>
<td>Minimize annoyance</td>
</tr>
<tr>
<td>Scrolling action should be bidirectional</td>
<td>Should be able to show previous work and advance to new blank space</td>
<td>Maximize physical value</td>
</tr>
<tr>
<td>It must automatically capture written material</td>
<td>Should capture in digital form at high resolution – must be legible and high-detail.</td>
<td>Maximize digital value.</td>
</tr>
</tbody>
</table>

Table E.2: Functional Requirements for Scrolling Table CFP
E.1.2 Lessons Learned

Testing was done by using table during team brainstorms. As well, two other 310 teams tested the table. With regards to goal of minimizing physical annoyance, it was found that:

- Anxiety about having to erase material when running out of space was avoided (+)
- Writing on the surface was close to exactly like writing on a normal whiteboard:
  - Dry erase behavior was good (+)
  - Surface sometimes was wrinkly, and did not stick to table properly (-)
  - Physical scrolling action was intuitive (+)
  - Physical scrolling action felt good: It was gratifying to signify progress in physical action (+)(+)

With regards to the goal of adding documentation value, it was found that:

- Having a physical record was useful, since one could scroll to find old work (+)
- Digital photos of physical record were not ideal:
  - Lighting conditions were bad and camera moved – stitching photos together was hard and not best result (-)
  - Resolution was not high enough (-)
  - Stitched digital record was very useful (+)(+)

E.1.3 Key Insights

We found that we were able to successfully minimize physical annoyance. Additionally, we also found that we enhanced physical experience: the act of scrolling and signifying progress was gratifying. This leads us to ask, in future work, *How else can we use this positive reinforcement?*

The stitched picture (Figures E.3 and ??) was useful because it allowed us to review our work away from the table – we could put it on Dropbox and then look at it from anywhere. We could talk about it remotely through Skype with our partners in Sweden. In these usage scenarios, however, we found ourselves wishing that we could annotate the pictures. This inspired the question: *What else can we do with this ‘idea timeline’?* This question is explored in the Annotated Timeline Mini-CEP.

E.2 Annotated Timeline Mini-CEP

E.2.1 Annotated Timeline Mini-CEP Development

Using the stitched together timeline from the Scrolling Table CFP, we wanted to see what else we could do with it. From our experiences using it to communicate and collaborate with the Swedish team, we formulated an informal wish-list of useful features:
E.3. Ambient Stimulus CEP

- It should be automatically uploaded on the web
- Users should be able to interact directly with it on the web
- Users should be able to add comments to parts of the timeline, and add comments to comments
- Users should be able to add details, such as documents, pictures, video, etc. to specific parts of the document
- Users should be able to ‘tag’ parts of the timeline as belonging to a certain task or thread of development

Implementing many of these things would be an involved process. To prototype the experience of looking back on such an annotated timeline, we mocked up and end-result in InDesign. It is shown in small size in Figure E.5.

E.2.2 Lessons Learned

Having such a timeline appears to be useful to look back upon – our opinion is biased, but feedback from teaching team, TAs, and some 310 classmates indicate that the annotated timeline was much more useful than the timeline alone in understanding our ideation process. But it is clear that the user-user and user-timeline interactions that go into making the end-product is an important part of the experience – we need to figure out what about those are critical, and then prototype them next.

E.3 Ambient Stimulus CEP

In designing Kungshall, we wish to look further than just physical environment. One possible aspect of this is sensory environment.

Motivated by this, the most basic question our CEP investigated is: How significantly can ambient stimulus affect team dynamics and creativity?

There is a large knowledgebase for creating spaces that create either diverging or converging behavior – the hard part is knowing what kind of space the team needs, and then changing the space accordingly. If ambient stimulus does indeed affect team dynamics, then we can ask: Can we combine real-time information about team dynamics and ambient stimulus to create a feedback control system for team dynamics by actively changing the space?

We walled off a corner of The Loft with white curtains, and put speakers inside, and a projector on the outside. It can be seen in Figure E.7.

Implementing such systems would be incredibly complicated. To prototype this, we used a Wizard-of-Oz method to implement four different ambient stimuli scenarios:
Dominance Feedback

*How does knowing who is dominating a conversation affect team dynamics?*

**Mechanism:** Each person in a team is assigned a color band. At the start of the brainstorm session, they are all the same size. When a person starts talking, their color band starts to grow, and the others shrink. A screenshot of the colored bars is shown in Figure E.9. **Implementation:** A moderator standing outside the room listens in and chooses which bar to grow in a simple software program.

Related Word Mapping

*Can word-mapping provide background inspiration to augment teams’ creativity with related keywords?* **Mechanism:** Project maps of words relating to keywords used in brainstorming sessions. **Implementation:** A moderator standing outside the room listens in and enters key words into WordVis.com, generating maps of related words. An example of a generated word map is shown in Figure E.10.

Inspirational Images

*Can we draw meaningful inspiration from images related to a conversation? How about unrelated images?* **Mechanism:** Project selection of related or unrelated images. **Implementation:** We prepared beforehand images that were related to the topics that the team was brainstorming, and projected them in a slideshow with 10-second durations.

Rhythmic Colors

*Can abstract color/movement/sound stimulate a team or steer its energy in certain directions?* **Mechanism:** Play either fast-paced and/or slow-paced music, with rhythmically synced video. Try to schedule pace so that it is fast-paced at beginning and then slow-paced in middle of sessions. Can choose to increase pace when energy is lacking. **Implementation:** We prepared the synced visuals/music beforehand.

E.3.1 Lessons Learned

Dominance Feedback

We tested this with Team Edeka, having told them what the bars mean beforehand, but not which color belonged to whom. Overall, it affected them greatly, but was a thoroughly negative experience:

- They found this to be extremely stressful and distracting: “I spent 25% of my attention thinking about it (-)
- This stress caused them to panic or to want to say things that weren’t especially helpful, just to get their bar to grow (-)
- Some were more stressed when they weren’t talking enough, others were stressed when they were talking too much and ‘bullying’ others (-)
They said that knowing speaking percentage as function of time could be useful.

They found it to be a discouraging form of negative reinforcement: “It feels bad to see your bar getting smaller” (-)

While it was a very negative experience, it was encouraging that the magnitude of the effect was great. Taking into account things learned from the other scenarios, a path forward with this scenario could include:

- Positive reinforcement instead of negative
- Observation of other metrics, such as movement or sound
- Subtle and slower-moving indicators, such as light level

Related Word Mapping

We tested this with Team EMN, having not told them what was going to occur in the space. Overall, it had little to no effect, but was sometimes distracting:

- Because the word maps were peripherally projected on the curtain and was mostly blank space, it was easy to ignore. Which was actually a benefit: They didn’t have to pay attention to it until they were looking for inspiration. (+)
- However when they did look at it for inspiration, it wasn’t useful: The words weren’t radical or far away enough from the conversation. (-)(-)

The lack of utility in this scenario mostly stemmed from the ‘related words’ lagging behind the brainstormfront. A path forward for this scenario should include ways to amend this:

- Occasionally project unrelated words
- Occasionally project antonyms rather than synonyms
- A smarter related word system – but this almost amounts to an automatic brainstormer

Inspirational Images

We tested this with Team Microsoft, having prepared a collection of both related and completely unrelated images beforehand. Overall, it was interesting at first, but had little effect after the images started looping:

- Pictures were distracting at the beginning: they had to pause conversation to process images (-)
- After that, pictures had little impact – not useful but not distracting either (-)

It was encouraging that the images were useful before they started repeating, but discouraging that they were mostly distracting and interrupted the flow of the conversation. A path forward for this scenario should address this:
• Images can be shown only when group activity level is low (integrating feedback mechanism from Dominance Feedback)

• Images should never repeat

Rhythmic Colors

We tested this twice, once with Clariant, and then with SAP. The test with Clariant showed a relatively small effect:

• Reactions to music were very subjective: “Fast is energizing” vs. “Slow helps me focus” (-)

• Easy to ignore the visuals: “too dark and to the side” (-)

During the test with SAP, there were a few differences: it was at night, so the visuals were a lot brighter relative to the room. Additionally, one of the curtains slipped, and the visuals were projected directly on the whiteboard rather than the curtain, as shown in Figure E.8 This led to some very interesting findings:

• They really liked the feeling of the fireworks on the board: it “makes me feel like I’m doing something that is sparkling”, it was a “starry board of ideas”. (+)

• They related the fireworks with their idea formation: “It’s like think, think, more ideas coming out” (+)

• They warned that visuals could be distracting if they were semantic – it was good to not need to think about the images

• Music added energy and helped a lot when there were silences in brainstorm. (+)

• Music could be distracting when energy level was already high – makes talking over music harder (-)

These very encouraging results, though accidentally found, could (and should) be explored further in combination with findings from the other scenarios:

• Music should adjust to energy level – inject energy during silences, and quieten during active talking (feedback)

• Fireworks should somewhat be related to the brainstorming actions - for even better positive reinforcement, rather than just random patterns

• More immersive visuals and sound could be highly interesting

• Localized sound so that each person gets the kind of music that makes them energetic
Key Insights

Throughout all the scenarios, teams found the spatial experience of being within the curtains to be really beneficial. They liked the isolation, cosiness, and semi-privacy. It helped them focus, and get away from the craziness of the rest of the loft. This emphasizes the importance of space fundamentals. The cosiness is important, and suggests an important factor:

$$\text{Cosiness Factor} = \frac{\text{Volume of Enclosed Space}}{\text{Number of People}}$$ (E.2)

The many findings from the scenario testing can be summarized by a few important insights:

- Ambient stimuli is indeed a very powerful tool
- Abstract cues are more effective and much easier to implement than smart semantic cues – they inspire the idea creators rather than the ideas
- And for inspiring people, positive reinforcement is much more effective than negative reinforcement
- Stimulus should depend on energy level of group – more when low, less when high; some form of feedback control could be promising.
Figure E.3: Timeline stitched together from photographs from Scrolling Table CFP
Figure E.4: Magnified view of a portion of stitched timeline
Figure E.5: Annotated Timeline CEP
E.3. Ambient Stimulus CEP

Figure E.6: Magnified view of a portion of Annotated Timeline

Figure E.7: Photograph of CEP room
Figure E.8: Photograph of brainstormer interacting with projected fireworks board from Rhythmic Colors scenario
Figure E.9: Screenshot of colored bars from Dominance Feedback scenario

Figure E.10: Screenshot of WordVis.com generated map of related words, centered around innovation