Improving the Future of Learning Through Enhanced Collaboration Methods and Platforms

by

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*"The best way to have a good idea
is to have lots of ideas."*[1]
— *Linus Pauling*

AUTHOR'S DECLARATION

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ABSTRACT - BRIEF DESCRIPTION OF THE PROJECT

In a rapidly changing world, to maintain relevancy in the face of competition, many businesses and sectors are re-examining how they develop the best product offering for their customers. This is especially true of the education system. Social trends and on-line connectivity are changing how people explore and experience the world, learn, interact, and work.

Inspired by how these changes are affecting the Informal Science Learning sector and it's needing to evolve in front of looming disruption, this Major Research Project examines the implications of critical trends and how they can be harnessed to co-create new shared value not only in this sector, but more broadly and globally.

The research starts with an examination of the importance, nature, complexity and challenges of creating public offerings (informal learning based content) in the typical science centre. Using the Ontario Science Centre as a case study, critical trends that might lead to business model change were examined.

Critical trends included the globally growing network of science centres, the success of involving customers in co-creation and the continuing advancement of remote collaboration technologies and capabilities.

In order to unpack the current state and potential of remote collaboration, expert interview research was conducted focusing on collaborative tools and methodologies and best practices. Further literature research also noted the growth of on-line experience platforms, and a convergence of co-creation, learning and work.

Most importantly, the research concludes that technological advancements and successes in remote co-creation suggest an emergent model for the improved future of learning, work, productivity and the potential for the crowd to democratically self-assemble and engage in design and problem solving.

ACKNOWLEDGEMENTS

DEDICATION

To Mom, Dad, Christine, Emma and of course Pien.

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Figure 1 - MRP Process Diagram. This diagram illustrates the steps and outcomes of this research project.

CHAPTER 1   INTRODUCTION

PREFACE

Imagine…

> *being able to work on,*
>
> *or learn or experience what you want,*
>
> *from where you want,*
>
> *when you want,*
>
> *with who you want,*
>
> *…to accomplish what you believe in…*

I have worked for the Ontario Science Centre for over 30 years as an experience designer and project manager. Every once in a while, there would come along moments approaching the scenario described above. These moments would prove the most satisfying. Dwindling funding, disruptive change in the competitive landscape and out-of-date ideologies have made those moments rare.

There must be a better way to work and to learn.

It is from this point that this research project was born.

This research also follows on my 2015 independent study '*Exploring Challenges and Opportunities for Informal Science Centres Through an SFI Lens*' which allowed me to broadly explore the Informal Science Learning field. I undertook this exploration to identify opportunities to use Strategic Foresight and Innovation tools and thinking to strengthen processes and outcomes in a field challenged with underfunding and limited resources.

For this research, the Ontario Science Centre became the locus – a case study to create a frame of reference for exploring future changes in learning and work. In this first chapter, I wish the reader to understand the context of Science Centres within the Informal Science Learning sector and its needing to evolve in front of looming disruption due to technological and social change.

Evolution in how we work, how we promote and share learning and how we structure our business model is critical to support growth in science literacy which is a fundamental need for the success and advancement of any society.

NOTE about terminology used.

I use the term **Informal Science Learning** to refer to a broad range of engagements with science outside the classroom. These include but are not limited to visits to a Science Centre, exhibitions, demonstrations, special programming, workshops, science kits, watching YouTube videos and other on-line exploration.

I also use the terms **Exhibition** and **Exhibition Experience** to refer not just to a collection of physical exhibits, but also to the range of engagements that are often created in association and in parallel processes. These also include demonstrations, programming, workshops as well as supporting websites, guidebooks and take-home activities.

GROWTH OF INFORMAL SCIENCE LEARNING

Informal Science Learning and Science Centres in particular experienced rapid growth in the last several decades. Organizations like the Association of Science and Technology Centers are connecting a growing global community though conferences and initiatives.

I believe there is much more to be done to connect and capitalize on the growing global web of talent and resources to support greater productivity and success in improving experience development for increased science literacy.

Growth in science literacy is critical to the success and advancement of any society.

Exploration of science and the encouragement of science learning and understanding has been a fundamental facet of human evolution and an underlying factor in successful civilizations. Rulers of ancient civilizations sponsored or encouraged scholarly pursuit of knowledge especially in warfare technology, medicine and engineering (such as canals, fortifications and palaces.)

In the late 7th century, Arabic Houses of Wisdom became centres for learning where research was sponsored and learning was passed from teacher to student.[2]

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[1] Find Quotes. (n.d.). Retrieved September 01, 2017, from https://www.goodreads.com/author/quotes/52938.Linus_Pauling
[2] Wikipedia. (2015). House of Wisdom. Retrieved from https://en.wikipedia.org/wiki/House_of_Wisdom.

During the Renaissance, aristocrats collected curiosities to exhibit to their friends. One such example was the Kunstkamera, established by Peter the Great in Saint Petersburg in the 17th century. Referred to as 'cabinets of curiosity' these were dedicated to preserving "*natural and human curiosities and rarities*"[3] such as deformed animals, still-born infants, mineral collections, skeletons (such as that of the world's largest man at the time), scientific instruments and illusions such as the zoetrope.

Peter once put the collection of still-borns on exhibition as accidents of nature, in part to dispel superstitious fear of monsters. Even at this time, science curiosities were used both for entertainment and education. The role of entertainment in education continues to be acknowledged today. The balance of 'tainment' in 'Edutainment' is often debated. Some question if an experience can be so much fun that the learning opportunity is lost in the distraction? On the other hand, if the experience isn't fun, will it simply be passed over by those craving stimulation?

In the early 20th century, the Deutsches Museum is credited with developing the first exhibits where visitors were encouraged to push buttons and work levers.[4]

In the early 60's, Dr. Frank Oppenheimer, a physicist (and younger brother of renowned physicist J. Robert Oppenheimer) received a grant from the NSF to develop new pedagogical methods for teaching science. This work resulted in "nearly one hundred models of classical laboratory experiments which could be used in aiding the teaching of physics to elementary and high school children. These models would *later become the core of the first exhibits at the Exploratorium*"[5] a science museum Frank founded in 1969. Frank and his models also influenced a concurrent project, the development of the Ontario Science Centre.

The Ontario Science Centre, a Canadian Centennial Project, was originally slated to house a collection of agricultural equipment. The first director of the centre hired a designer, Taizo Miyake and a team of young designers to plan the exhibitions. Interaction between this

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[3] Wikipedia. (2015). Kunstkamera. Retrieved from https://en.wikipedia.org/wiki/Kunstkamera.

[4] Wikipedia. (2015). Science museum history. Retrieved from https://en.wikipedia.org/wiki/Science_museum#History.

[5] Wikipedia. (2015). Frank Oppenheimer. Retrieved from https://en.wikipedia.org/wiki/Frank_Oppenheimer.

team and Frank Oppenheimer resulted in the question 'What do visitors really want to do at a museum?' Whereas the Exploratorium evolved a style of rough prototypes created by scientists and artists, the Ontario Science Centre evolved a more designed, styled and crafted approach due to the presence of European craftsmen exhibit builders working together with scientists and industrial designers in a more design driven process.

From the 70's on, the informal science centre landscape experienced constant growth. Membership to The Association of Science-Technology Centers has grown from 20 in 1973 to 660 institutions worldwide.[6] Governments and the science community recognize informal science centres as an important component of building a broader base of science literacy within society and inspiring the next generation to pursue careers in science.

The success of interactivity has been a mixed blessing for science centres. The costs for developing interactive exhibitions are high and difficult for largely non-profit organizations to fund and update. The idea and appeal of 'interactivity' (whether led and inspired by science centres, or just a natural evolution of human curiosity, desire to explore, be entertained and engage in story-telling) has grown in every facet of contemporary life. On-line games and stories are interactive, art installations are interactive, the leisure and entertainment industry focuses on engagement and interaction. This explosion of options and competition for the "watch time" of visitors has created challenges for informal science learning institutes. There is a struggle to find the balance between their educational focus and competing with the leisure and entertainment industry that is less constrained with what is "good" for people as opposed to what compels them to choose to attend.

Modern science centres have been a tool and portal supported by society in this endeavor. Methods and methodologies of science communication and learning are constantly advancing and have been both reflected and advanced within the informal science centers of the day. Societal and technological changes are at play in how science centres provide engagement and in the various typologies of engagement that have evolved.

See **Appendix A - Evolution of Science Centre Interaction Typologies**

See **Appendix B - Methodologies for Creating Engaging Experiences**

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[6] ASTC. (2015). About ASTC. Retrieved from http://www.astc.org/about-astc/

CURRENT CONTEXT FOR SCIENCE CENTRES

Science centres currently struggle to balance education and entertainment, generally in the context of not enough resources...internally debating beliefs of what the public should know about and what we believe they want to experience. Our visitors and our market are changing and we find ourselves competing with other powerful draws for the public's time and attention.

At a time when continued government support for educational institutions is uncertain, we need to critically examine our business model, processes and decision-making strategies.

Technologies already here (the internet) and on the immediate horizon (such as commercial ubiquitous Virtual Reality) will greatly change science education and offer new opportunities of engagement but will also significantly disrupt current business models.

Knowledge of our visitor and their perception of valued experiences is critical. Embracing new forms of engagement in the digital world need to be tested and evaluated. Equally important is informing visitor perception with regard to our key differentiators and value proposition.

Also important, will be building a living organization able to transform as needed to be responsive to the increased speed of scientific, technological and societal change. New business models need to be tested. New more productive, innovative and collaborative work processes need to be implemented if we are to evolve ahead of advancing societal change. Perhaps as we recognize the importance of innovation in a successful society, a new role of the science centre as an innovation incubator may evolve.

I believe that one of the key factors in the next iteration of Informal Science Learning is interconnecting the global community and harnessing the potential of collaborative content generation.

CURRENT EXHIBITION EXPERIENCE DEVELOPMENT MODELS AND PROCESSES

Currently, the most common model for informal science exhibition creation is development by small co-located inter-disciplinary teams based on or driven by the mandate of a single institution. This might be to create a new permanent exhibition for an institution and its local audience, or a travelling exhibition that will be shared with other institutions. In the last decade, a competitive, even crowded for profit industry has emerged where independent studios, sometimes in collaboration with educational institutions or sponsors create travelling exhibitions.

Exhibition development is expensive. The challenge is that the development costs tend to only be amortized over the cost of the single exhibition produced. It would not be uncommon to spend a million dollars on research, development, design, testing and manufacturing set up for a consumer product, but that might only amortize out to a dollar per product produced. Compare this to the creation of a single interactive exhibition with several dozen visitor interactives, each to be researched, designed and manufactured to withstand the use of a million individual users. Because only one

exhibition is built, the development costs all go to the single project, and it can take years for that exhibition to reach its potential audience.

Different institutions are connected together through a number of national and global associations like the American Alliance of Museums (AAM) and the Association of Science and Technology Centers (ASTC). Many on-line information repositories and blogs exist through these organizations.

SMEC, The Science Museum Exhibit Collaborative, is an example of a group of museums working as a collective, each creating an exhibition which they share in rotation.

A characteristic of the informal science industry is that it tends to attract creative people, idealists who want to share science, but who often want to pursue projects of personal interest in the way artists pursue their passions. Attention to market needs are often not considered. What one institution creates often doesn't meet the needs of other institutions.

On the positive side, the market itself is characterized by constant growth in numbers of institutions worldwide, but this institutional museum customer base is spread out and typically underfunded. ASTC reports to have over 600 member institutions in 48 countries.[7]

Public exhibitions, whether temporary or permanent collections, have been one of the primary 'products' offered by science centres to their customers. Exhibition development is product development, but I have observed it is often not thought of in those terms, or through the critical lenses typical of product development.

Figure 2 illustrates the hierarchical process structure for exhibition development typical of the Ontario Science Centre over the last two decades. Management decides on a single project to pursue often before a clear demand from other science centres or support from sponsors is confirmed.

Projects are initiated on a management hunch or someone's personal interest. Experts are involved in the content development mostly for ensuring scientific accuracy. The process allows for only minimal upfront public engagement. Sponsors and other potential science centre venues are often only approached late in the process.
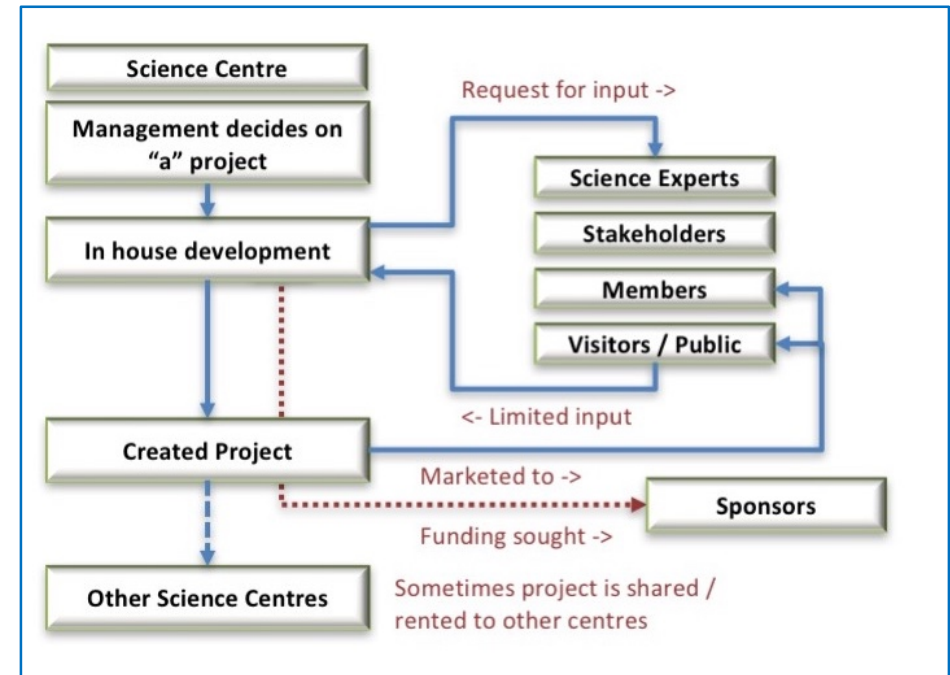
Figure 2 - Typical Model for Exhibition Development - Management decides on a single project to pursue often before a clear demand from other science centres or support from sponsors is confirmed.

Looking at the diagram as a system, there are aspects that do not seem to make sense. My initial research questions (Figure 3) start to examine this.

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7 http://www.astc.org/membership/   21 June 2017

RESEARCH QUESTIONS
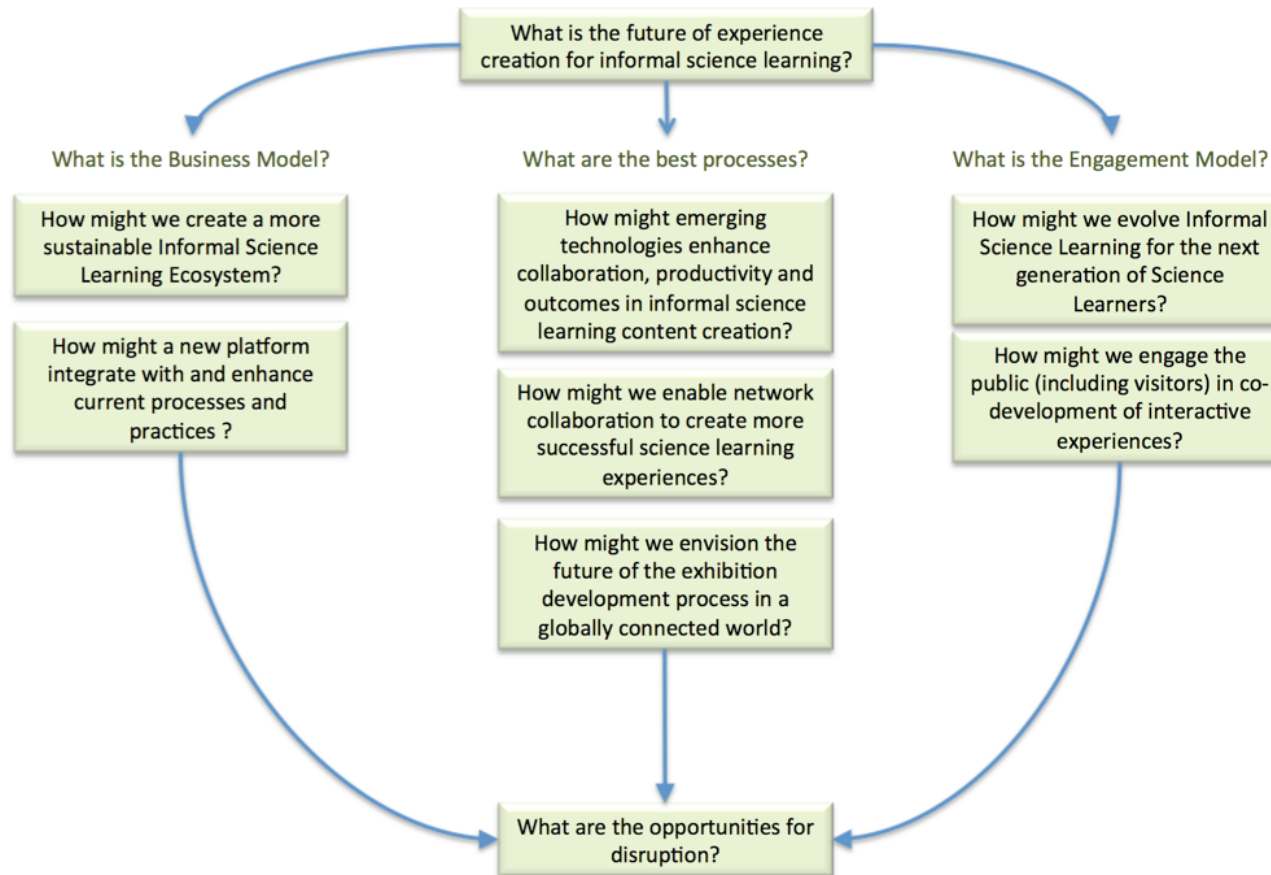
Figure 3 - Research Questions were considered in framing the problem.

CHAPTER 2   BROAD SCAN OF RELATED FIELDS OF RESEARCH

The initial phase of my research involved a broad scan of methods and trends that might influence and effect the Informal Science Learning sector. Five areas stood out as being important to examine and consider in the search for a new improved model for creating learning experiences.

- Experience Development Methodologies
- Co-creation Methods
- Emerging Technologies and Trends
- Collaborative Processes
- Use of Technology in Collaborative Work

EXPERIENCE DEVELOPMENT METHODOLOGIES

There are certainly variations to approach exhibition or experience development. Most would follow an approach similar to a common design process. Steps would include:

- Identifying a problem or need (a topic for an exhibition)
- Research to identify content
- Conceptualize methods of communicating content
- Design and Refine
- Manufacture

Appendix C - The Exhibition Development Process describes a typical linear exhibition development process. This particular process shows a fairly formal method to allow client control and approval at key points along a generative iterative process.

There are several failure points in the linear style exhibition development.

- Lack of upstream involvement by downstream implementation specialists such as writers, prototypers and builders. A shared development platform allows better upfront participation and

situational awareness for those usually further down the process pipeline.

- A linear process with handoffs from research to design to production does not benefit from diversity of thinking.

- A linear process creates bottlenecks where downstream processes cannot start until something upstream is completed.

- It is costly to bring together external subject matter experts and other stakeholders like sponsors and visitors for development meetings.

There are advantages to recognizing the iterative nature of design development and the benefits of non-linear components to the exhibition development methodology.

Figure 4 examines the activities and outputs of the exhibition development process focusing on inter-relations. It reveals inherent complexity. Something about this diagram reminds me of a science video I once saw that showed the movements of ants and bees.

Bees and ants are known for a behaviour where many workers act within a collective methodology and evolved behaviours to each independently advance small pieces of the mission of the colony.

Biomimicry is a form of innovation that finds inspiration in the structures and processes found in nature. Perhaps a component of a new innovative approach may be found in the processes of highly evolved collectives in nature.

A larger collective or development team might be able to adopt some of the advantages of ant behaviour if an improved methodology allowed for this. A new methodology might contain templates and procedures for collaboratively undertaking some processes in independent non-linear ways.

Exhibition Development Activity and Output System Diagram

LEDGEND
- Stage
- Milestone documents
- Preliminary Items to define
- Generative activities
- **Final Work Product /Outputs**
- Influence →

Problem Finding (Project Definition)

Ask Questions
- Is there a problem to solve or need?
- What is interesting, trending, hot?
- What should people know?

Topic

What are the building blocks / concepts for learning & understanding subject matter?

Stakeholders

Audience

Broad Scan Research

Project Vision, Mission & Goals

Concept Brief (1 pager)

Concept Development

Brainstorming

Thumbnails

Communication Goals

Engagement Model

Experience Ideas

Sketches

Draft Concept Specs

Key Concepts

Content Brief

Preliminary Experience Concepts

Voice

What is the Big Idea?

Draft Copy

Design Intent Drawings

Design Development

Look & Feel

Prototyping

Visualization

In-depth Content Research

Preliminary Floor plan

Final Concept Specs

Exhibition Brief

Design & Visual Communications Standards

User-Centered Iterative Testing

Final copy

Experience Storyboard

Graphic Design Layouts

Floor plan

Exhibition Model

Manufacturing Detailing and Engineering

Final Exhibition Plan

Web Content **Demonstrations & Programming** **Visitor / Family Guide** **Education Guide**

Fabrication Drawings

Fabrication

Manufacturing

Testing & Commissioning

Exhibits and Experiences

Documentation & Close out

Assessment & Recommendations

Remediation

As-Built Drawings

Operational Manuals

Open Source Rollout

Virtual Exhibition

Figure 4 - System Diagram of Exhibition Development Activities and Outputs. Illustrates the complexity of iterative and interlinked processes and documents.

To find other consideration for a new model, I looked across a range of other design related fields including architecture, product design, game design and the movie industry, to draw inspiration from their best practices. Other considerations for a new model might include:

Project Definition (Problem Finding)

- Subject and content definition – what is the need?
- Audience definition – who should benefit from this knowledge?

Conceptualization / Development

- Extensive use of market research and focus group testing.
- Granular understanding of the target audience's needs and values.
- Ensure breadth of diversity within the collaborative cohort. Although the current exhibition development process is at its core multi-disciplinary, the distribution, influence, and weight of the diverse discipline voices at the table will be important to balance.
- Shared co-edited research and workshop reports.

Content Research

- Gathering content from global experts.
- Shared co-edited documents for individual content research streams.
- Shared co-edited concept specifications.

Design, Prototyping and Testing

- Shared co-edited, co-critiqued design development documents.
- Well documented design, manufacturing standards and implementation processes.
- Design detailed to a level that allows accurate quantifying, estimating and production planning.
- Granular storyboarding or journey mapping can be used to choreograph every aspect of the visitor's experience. This can allow for critique in building emotional engagement and participation including opportunities for, anticipation, tension, excitement and surprise. This method would be especially important in a more immersive exhibition experience such as potential Virtual Reality, Augmented Reality and Mixed Reality experiences.
- Future exhibition development might adopt strategies used in game design to allow visitors to customize their experience as well as provide options for different experience paths that encourage return engagement.
- Highly detailed use of modeling software to test visual, functional, engineering and manufacturing processes in both virtual environment and through rapid prototyping.
- Create engagement and emotional response wrapping strong characters and story in theatrical lighting, sound and stage effects.

Business Model

- Amortization of development costs over a large production allows for higher design budgets and quality. Economies of scale.

- Co-creation models allow potential client institutions and sponsors to participate in project development. This inclusivity builds interest and commitment leading to cost sharing and lower cost outcomes.

CO-CREATION METHODS AND STRATEGIES - IN WHAT WAYS DO PEOPLE CO-CREATE?

Co-creation is a current buzzword, but hardly a new concept. One only has to look to the "old-fashioned barn raising" or the pageantry of pagan festivals to see how communities have always come together to create for mutual benefit.

What is important is that the typologies of co-creation are constantly expanding to suit new social needs and technologies. Something can be learned by examining these different modes for their traits.

The article *5 Types of Consumer Co-Creation Research* lists Social Media, Online Community Panel, Co-creation Workshop, Small Focus Group and One on One Interview[8] and evaluates each co-creation approach in terms of important dimensions such as unique thoughts, concentration, environment, subconscious access, emotional access, problem solving and observation of body language.

In *Come together: The rise of cooperative art and design* (Spampinato, 2014) the author shares his findings from interviews with forty groups of co-creators in diverse applications from the Occupy! Movement to theatre troupes; from media activists to pranksters; from public art creators to flash mob organizers and more.

Spampinato "explores the mechanisms that lie behind the collective production of visual culture today" by asking "a series of questions about the motivations, logistics, and objectives that drive artists to give up their egos and embrace anonymous and shared operations…. What emerges is a common desire to transform viewers into

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[8] 5 Types of Consumer Co-Creation Research - The Strategy Distillery. (2014). Retrieved August 11, 2016, from http://www.thestrategydistillery.com/news/consumer-co-creation-research/

producers, making them aware of their potential as agents of change."[9]

C. K. Prahalad and Venkat Ramaswamy examine the benefits of co-creation in *The Future of Competition: Co-creating Unique Value with Customers (2004.)* They suggest that co-creating experiences with customers will be critical to future successful business models. To compete effectively there will be a need to build *"new infrastructure capabilities, as well as new functional and governance capabilities— capabilities that are centered on co-creation through high-quality customer-company interactions and personalized co-creation experiences."* [10]

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[9] Spampinato, F. (2014). Come together: The rise of cooperative art and design. New York, NY: Princeton Architectural Press.

[10] Prahalad, C., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. Journal of Interactive Marketing, 18(3), 5-14. doi:10.1002/dir.20015

EMERGING TECHNOLOGIES AND TRENDS THAT COULD ENHANCE SUSTAINABLE BUSINESS MODELS FOR INFORMAL SCIENCE CENTRES

Rapidly changing technology is influencing every aspect of modern life, personal, social and business. Technologies build on each other, expand their capabilities, merge and refine in the pursuit of new benefits, efficiencies and utility. Technologies allow new ways to solve problems. Following are nine technologies and trends that are having an impact on how businesses succeed and how people interact.

Crowdsourcing

Crowdsourcing is the process of connecting with large groups of people via the internet to tap into their knowledge, expertise, time or resources. Typically, some sort of exchange is involved. This could be work in exchange for a monetary reward. It can also be less tangible, for example, mined data in exchange for an experience of value.

One example, Zooniverse.com, via an internet based platform, allows people the experience of learning and engaging in scientific research in an area of their interest. In exchange, each Zooniverse project receives thousands of hours of otherwise unaffordable data analysis.

For a Science Centre interested in enhancing its offerings, crowdsourcing might be used for content/science research, concepts, brainstorming, market research and even design.

KickStarter.com and Indiegogo.com are two of many crowdfunding sites where projects can raise funds through either donation or pre-sales of a proposed project or product under development.

Crowdfunding can provide additional benefits such as customer development, market research at even preliminary stages, market validation as well as amplify market visibility and awareness.

A scan of these sites showed that crowd-funding for exhibitions was not common. There may be an issue because exhibitions are local based. It may be hard to gain the advantage of capturing a small segment of a global audience. However, this might be different if the product offering was a virtual exhibition that could be accessed from anywhere.

📄 Virtual prototyping

3D computer modelling software is advancing the ability to create realistic concepts and prototypes for market research testing and evaluation in advance of manufacturing. It is now possible to model an entire exhibition and test visitor interactions.

📄 Virtual reality / Augmented reality / Mixed reality

These technologies are poised to provide a whole new generation of experience and interactivity. On one hand, as with instant information on your smart phone and entertaining science content videos on YouTube videos, the expansion of use of these technologies will bite into the informal science market share, once held largely by science centres. On the other hand, these technologies may provide a new medium or taxonomy for science centres to engage society on a global scale.

📄 Gesture based technologies

A recent article *Future Gestures will define us* on ShapingTomorrow.com highlights coming gesture technologies. These technologies are going to add new possibilities for interaction in the exhibition arena. These include:

- near field communication (NFC) potentially between a visitor's device and an exhibit.
- 3D mobile phone displays

- "subvocalized conversations, eye movement interactions, and gestures with something like an AI or Siri-servant"[11]
- "Game controllers and gesture-driven artificial intelligence will give way to completely immersive game experiences."[12]
- "Ultrasound technology that enables mobiles and tablets to be controlled by gesture could go into production as early as next year."[13]

▤ Use of disruptive on-line design services

The internet is allowing growing opportunities to access freelance design and other services either as fee for service or in the form of competitive contests.

- www.fiverr.com

  An on-line source that extends human resource capabilities for: Graphics & Advertising, Online Marketing, Writing & Translation, Video & Animation, Music & Audio, Programming & Tech, Design including: Cartoons & Caricatures, Logo Design, Illustration, Book Covers & Packaging, Photoshop Editing, Flyers & Posters, Banner Ads, Social Media Design,3D & 2D Models, Web & Mobile Design

- www.designcontest.com

  Create an on-line design brief, name a prize, post a contest, choose your preferred design from on-line submissions

- https://www.onlinevideocontests.com/

  Post a contest and prize for creation of videos that suit your marketing or business goals. Use the results linked to social media to create more marketing impressions.

If used effectively, these can dramatically reduce costs and overheads. There are tradeoffs to this form of outsourcing, but certainly benefits if used to deal with excess capacity issues.

▤ Online collaboration methods

The technological landscape for on-line collaboration has rapidly expanded from its beginnings of sharing ideas and documents via email and blogs. Social Media allows concurrent sharing of ideas and tracking of meta-data with an unlimited audience. Crowd sourcing of ideas and expertise is available through sites such as www.geniusrocket.com, www.innocentive.com, and

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[11] Athena (2015). Future gestures will define us. Shaping Tomorrow. Retreived from http://www.shapingtomorrow.com/home/alert/569461-Future-gestures-will-define-us
[12] Athena (2015). Future gestures will define us. Shaping Tomorrow. Retrieved from http://www.shapingtomorrow.com/home/alert/569461-Future-gestures-will-define-us
[13] Athena (2015). Future gestures will define us. Shaping Tomorrow. Retrieved from http://www.shapingtomorrow.com/home/alert/569461-Future-gestures-will-define-us

www.thesmartcrowd.com as well as software suites like www.brightidea.com.

- Google Docs and Wiki's already allow multiple shared contributions to the development of individual documents.

- Padlet.com is one of many online document organizing and sharing websites that allow a community to share information and ideas across distance and organize work.

- MURAL.ly has become much more than a virtual whiteboard, growing the boundaries of online collaborative work with a library of methodologies, templates and techniques for co-design.

- Virtual worlds such as SecondLife.com allow virtual prototyping of spaces that can be experienced, commented on and even modified by a community of users.

- Video conferencing such as GoToMeeting.com provide telepresence and many hardware-software integrations that are bringing people together in increasingly more successful ways.

Engineering and modeling programs are now enabling users in different locations to work together in real time on part and product design.

These technologies are constantly evolving their capabilities to allow people to collaborate successfully. This is driven by a basic premise that the future of innovation is the successful collaboration of the best,

most diverse thinking. A sign of what is to come, is how our youngest generation remotely interact with a group of friends to share the same music, interact, dance and create video with a 'live stream' facilitated by their hand-held smart devices.

3D virtual reality headsets such as the coming Microsoft HoloLens will make virtual presence activities common and eventually potentially ubiquitous.

As these technologies advance, they will continue to improve collaboration with teams and collectives and enable more successful partnerships.

Co-Creation Platforms

Co-creation platforms are an emerging business model where a company provides a platform that allows an on-line community to work together with the company to create a product or item of value. Both the company and the community benefit monetarily from the collaboration.

For example, Quirky.com has built a type of co-creation platform for product development and implementation. Members put forward

ideas for products or even completed designs. The community works together on line to access and develop the concept through various stages, voting at key points. Members of the community gain a stake in the project through their contributions. The core team at Quirky takes successful projects through to market. They even offer products for sale through the site. Each product tends to have a single owner of the idea.

📄 On-line Communities of Practice and Affinity Spaces

Although Communities of Practice are not a new idea (one can look to medieval guilds and even organized religion) the dawn of the internet has enabled people from around the globe to come together to communicate, share and learn about crafts, skills, interests and professions.

In *Cultivating Communities of Practice: A Guide to Managing Knowledge* (Wenger 2002) the argument is made "*that communities of practice - when managed correctly - can be the key driver of organizational success.*"[14]

The success of such communities is driven by "*their ability to generate enough excitement, relevance, and value to attract and engage members.*"[14] This is distilled down to a critical ingredient: "*a sense of aliveness.*" [14]

Wegner et al put forward seven principles of designing for this "aliveness" including:

1. *"Design for evolution*

2. *Open dialogue between inside and outside perspectives*

3. *Invite different levels of participation*

4. *Develop both public and private community spaces*

5. *Focus on value*

6. *Combine familiarity and excitement*

7. *Create a rhythm for the community.*"[14]

It would be reasonable to consider these principles in motivating on-line co-creation.

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[14] Williams, P. (2002, May). A community of leading knowledge-based organizations dedicated to networking, benchmarking and sharing best knowledge practices. [Review of Cultivating Communities of Practice: A Guide to Managing Knowledge]. Knowledge Management. http://www.providersedge.com/docs/book_reviews/Cultivating_Communities_of_Practice.pdf

Similar to Communities of Practice, the explosion of on-line Affinity Spaces is important to recognize as a potential source of inspiration for Informal Science Learning opportunities.

> *"Affinity spaces were first defined by James Paul Gee (Gee, 2004; Gee, 2005) as a way to understand how spaces – physical, virtual, and blended ones – provide opportunities for individuals through their communications within groups to develop affinity for a topic, such as media objects (e.g., games such as The Sims, media fandom such as Star Trek) and for practices (e.g., knitting, car repair, or gourmet cooking) (Duncan & Hayes, 2012, p. 7)."* [15]

Gee sees affinity spaces as different than a 'community of practice' in that the content evolves through two-way social interactions and practices such as sharing content and discussions. Membership requirements are much looser.

- ❑ *"Affinity spaces can have a number of formal features, although a given space may not embody all of them (Gee, 2004):*
- ❑ *Common endeavor, not race, class, gender, or disability, is primary.*

- ❑ *Newbies and masters and everyone else share common space.*
- ❑ *Some portals are strong generators, i.e., participants create new content, works, projects.*
- ❑ *Content organization is transformed by interactional organization.*

- ❑ *Both intensive and extensive knowledge are encouraged.*
- ❑ *Both individual and distributed knowledge are encouraged.*
- ❑ *Dispersed knowledge is encouraged.*
- ❑ *Tacit knowledge is encouraged and honored.*
- ❑ *There are many different forms and routes to participation.*
- ❑ *There are lots of different routes to status.*
- ❑ *Leadership is porous and leaders are resources."* [16]

Recognition of these qualities is critical in understanding what the successful motivators are for sustaining on-line participation and co-creation. According to Gee:

> *"An affinity space is not merely an interest-driven group. Passion brings people to affinity spaces and passion is the important part. It is beyond interest. Affinity spaces have the potential to kindle what begins as a small interest*

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[15] Affinity Spaces for Informal Science Learning: Developing a Research Agenda(Rep.). (2015). Twin Cities Public Television, Indiana University, University of Bradford. Retrieved from http://www.informalscience.org/sites/default/files/AffinitySpacesFinalReport.pdf

[16] Affinity Spaces for Informal Science Learning: Developing a Research Agenda(Rep.). (2015). Twin Cities Public Television, Indiana University, University of Bradford. Retrieved from http://www.informalscience.org/sites/default/files/AffinitySpacesFinalReport.pdf

into a passion.
Affinity spaces are not about individual intelligence, but collective intelligence. These spaces exist because the participants have an affinity for something, not because of race, class, or gender. If someone is there for a moment they are in it. Beginners and professionals can all participate. There is no gatekeeping.
Roles are flexible; sometimes you teach sometimes you learn. Standards are internal and indigenous; there are no top-down standards. Moderation is contested and negotiated. In some spaces, one has to earn the right to have opinions. Others are very nurturing. Affinity spaces are fluid by definition. Affinity spaces can go in and out of existence. They are prone to emergent results. They are squishy. They do not have well-defined boundaries." [17]

Figure 5 "*Ethority's Global Social Media Prism - Digital Landscape & Conversations*" illustrates a sampling of Social Media spaces and categories. It is representative of the expansion of on-line platforms that support sharing experiences and co-creation. Most of these are exemplary of Affinity Spaces.

Something that is important to recognize is that these spaces – these co-creation platforms – enable many more people to interact then previously possible. There, they can be inspired by others, share new ideas, build on other ideas and create and share new content. All of these activities generate both personal and shared value.

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[17] Affinity Spaces for Informal Science Learning: Developing a Research Agenda(Rep.). (2015). Twin Cities Public Television, Indiana University, University of Bradford. Retrieved from http://www.informalscience .org /sites/default/files/AffinitySpacesFinalReport.pdf
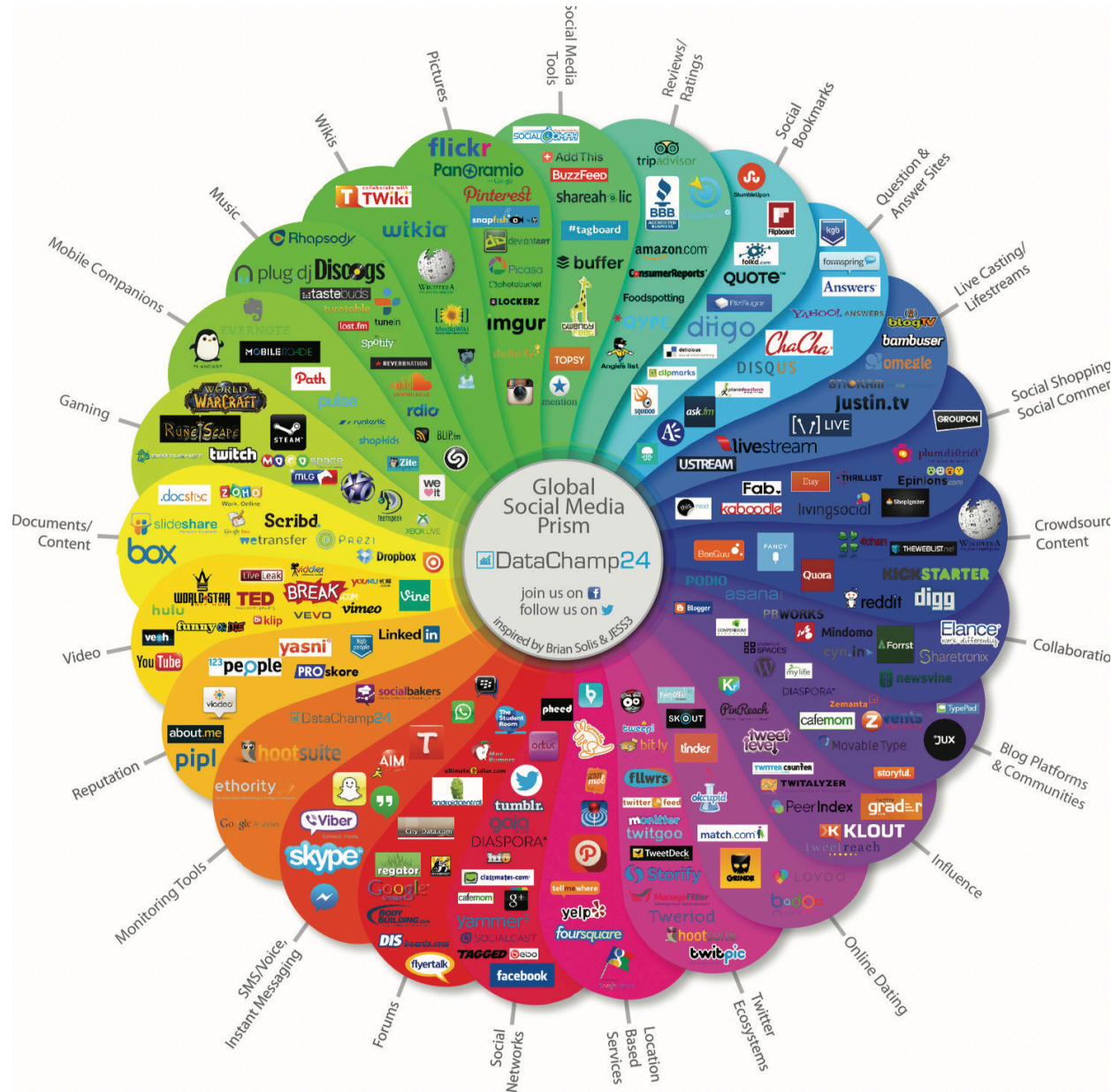
Figure 5 - Ethority's Global Social Media Prism - Digital Landscape & Conversations. (n.d.). Retrieved July 29, 2017, from https://ethority.net/social-media-prism/

Internet enabled "platform" based co-creation is exploding...
...and the resultant amplification of global creativity will be a force in our shared future.

22

COLLABORATIVE PROCESSES AND GROUP DYNAMICS

Collaborative Processes and Group Dynamics are critical to success in all team based work. In the current exhibition development model, often the process is led and driven by a creative "principle" person, whose experience pushes the vision of a project, followed and supported by a multi-disciplinary team.

On-line co-creation may necessitate flipping many of the typical leadership conventions giving the co-creators more creative "agency" in exchange for the benefit of diverse "crowd-sourced" contributions or expertise. Managing the process may involve setting the stage and goal, using much more gentle guidance, nudging and tweaking collective creativity, and providing the 10,000-foot view of emerging clusters of success and opportunity.

To be successful for co-creation, the platform will firstly necessitate meeting the needs of the many in terms of social comfort, cultural sensitivity and egalitarian participation.

The article **How to make distance work work (**J. Olson, G. Olson, 2016) describes four factors that are known to allow distance teams to succeed:

❑ *"assigns independent work modules to locations so they don't have*
to communicate much;
❑ *is made up of people who have worked together, have common ground and common work styles, and like working together;*
❑ *adopts an explicit management style that makes decision-making clear, promotes an open, inclusive atmosphere, and has details worked out;*
❑ *uses technologies to support communication, coordination, the sharing of data/knowledge, and is supported by an infrastructure powerful enough (both in networking and computational power)." [18]*

The Olsens go on to suggest that the above situation is rare. My research explores how to adapt to mitigate their implied challenges of "*out of sight out of mind, trust, culture and time zones.*"[19]

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[18] Olson, J. S., & Olson, G. M. (2014). How to make distance work work. Interactions, 21(2), 28-35. doi:10.1145/2567788
[19] Olson, J. S., & Olson, G. M. (2014). How to make distance work work. Interactions, 21(2), 28-35. doi:10.1145/2567788

The Olsens also identify the critical role of technology and the importance of covering a range of needs required to support remote collaboration. In Figure 6 below they present a taxonomy of technologies required to support distance work.

Establish the tech to support your team

CLASSIFICATION OF TECHNOLOGIES TO SUPPORT DISTANCE		EXAMPLES:
Communication Tools	Email and texting Voice and video conferencing Chat rooms, forums, blogs, and wikis Virtual worlds	Slack Skype, Google Hangouts, Conf Phone MediaWiki, Confluence Wiki Second Life
Coordination Tools	Shared calendars Awareness tools Meeting support Large visual displays Workflow and resource scheduling	Google Notifications (calendar, email, text) Notetaking (assign 'rounds') Team dashboards, task boards ZenHub
Information Repositories	Databases Shared files Blogs or wikis Laboratory notebook (online)	Google Drive, DropBox, Sharepoint Google Docs, (+ code repo/scm) GitHub Internal or external blog, wikis (above) Evernote, OneNote
Computational Infrastructure	System architecture The network Large-scale computational resources Human computation	(Computational Infra for another day :) ADD: Shared surface collaboration tools Mural, Stormboard Google Docs

→ Table 1. Classification of technologies to support distance work.

Figure 6 - Classification of technologies to support distance work (J. Olson, G. Olson, 2016)

Jeff Gothelf is a designer, team leader, coach and the author of LEAN UX Designing Great Products with Agile Teams. In his blog posting **Designing with remote teams** (J. Gothelf, 2013)[20] Jeff notes that although he is an advocate for co-located teams,

> *"…the reality of distributed teams is not lost on me…. While the benefits of in-person collaboration and communication are clear, it doesn't mean they can't be achieved with remote colleagues."*

It would seem there is an ongoing debate about the success of remote workers.

> *"Certain companies, like Automatic – makers of WordPress, have an entirely remote workforce and swear it's the only way to work. Other companies, like Yahoo!, have made headlines recently when CEO Marissa Mayer demanded all remote employees come back to the office." [21]*

Gothelf points to context and culture as key areas to examine. He refers to Jason Fried's warning of the creation of a "here" culture and a "there" culture where remote workers become outsiders and disconnected from the company. Distributed companies like **37 Signals** seem to know how to overcome this through practices like getting teams together at critical points in projects, or ensuring that new employees have an onboarding process in the office for evaluation and bonding.

Another common theme that Gothelf also identifies is the need for trust as a cornerstone of successful remote work culture.

Gothelf identifies five main challenges that need to be addressed with remote collaboration:

1. ***"Poor Communication –*** *this was, by far, the biggest complaint for distributed teams. Colleagues felt like they were not included in decision-making activities and were unclear why those decisions were even being considered. They didn't know their colleagues that well and felt awkward interrupting them during the day and providing critique on their work.*
2. ***Slow progress*** *– many respondents complained that their teams felt like they were moving slower. At the very least it was clear that the perception was one of slower progress.*
3. ***No team-building or camaraderie*** *– some team members never meet in real life. Without some level of shared experience outside the realm of "the project" there was a distinct lack of camaraderie amongst remote teammates. We spend the majority of our awake time working. For many folks, this is their only social outlet. When*

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[20] J. Gothelf (2013). Designing with remote teams, http://www.jeffgothelf.com/blog/designing-with-remote-teams/ March 25, 2013, downloaded 25 Nov, 2016

[21] J. Gothelf (2013). Designing with remote teams, http://www.jeffgothelf.com/blog/designing-with-remote-teams/ March 25, 2013, downloaded 25 Nov, 2016

the office component is removed, all that's left is the work. Jason Fried touts this as a benefit as it leaves nothing but the work to judge the merits of an employee's contribution. However, for many folks this is starkly missing from their work experience.

4. *Lack of collaboration – different time zones, languages, priorities and obligations leave many distributed teams working on their own. Productivity may soar in these situations but many survey respondents seem to miss collaborating with their colleagues.*

5. *Language and culture barriers with team members in other countries – while this can certainly fall into the poor communication bucket, the challenges with foreign colleagues are unique enough to warrant their own category. Building rapport with colleagues from your own country can be difficult enough. When you need to build that rapport with colleagues who speak a different language, follow different customs and have culturally-different approaches to work it becomes exponentially more difficult."[22]*

Methods to mitigate these challenges include:

- Use of video conferencing, even to the extreme of constant virtual presence.

- In person kick off meetings.

- Careful team selection looking for signs of good communication and acceptance of responsibility.

- Use of web based tracking tools.

- Knowledge management systems.

- Instant messaging.

- Cloud based sketching platforms.

- Virtual social events.

- Virtual celebration and inclusion through posting of work and event video for members who can't attend.

- Idea sharing platforms (Virtual Whiteboards) such as Pinterest.com or MURAL.co.

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[22] J. Gothelf (2013). Designing with remote teams, http://www.jeffgothelf.com/blog/designing-with-remote-teams/ March 25, 2013, downloaded 25 Nov, 2016

Dan Brown is a Designer, Co-founder of Eight Shapes, an entirely distributed design firm and author of Communicating Design and Designing Together.

> *"Successful design projects require effective collaboration and healthy conflict."*[23]

Dan suggests that conflict is inherent in the process of clarifying and refining and creating common understanding. With this in mind, what makes remote collaboration challenging is that it adds additional barriers to successful conflict management due to missing interpersonal cues.

In his June 2016 blog Collaboration & Creativity: Getting into the Right Mindset, Dan explores the relationship between collaboration, mindset and creativity. He suggests that to be creative, designers need to cultivate mindsets that are curious, skeptical and humble; and to work successfully within the requisite productive conflict, adaptive, collective and assertive mindsets are necessary.[24]

In summary, a successful remote collaboration platform will have to incorporate or address the following principles and components:

- A clear purpose.
- Facilitate communication as close to person to person as possible.
- Build a sense of community, shared values and common goals.
- Meet the needs of the many in terms of social comfort, cultural sensitivity and egalitarian participation.
- Instill into participants and users the development, implementation and reverence for creative and collaborative mindsets through methodology and requisite values promoted by cultural cues embodied in the platform.
- Provide tools and templates for sharing of knowledge and ideas.
- Provide the scaffold for sharing, discussion, debate, critique and the resultant co-created outcomes.

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[23]   Brown, D. M. (2013). Designing together: the collaboration and conflict management handbook for creative professionals. Berkeley (California): New Riders.

[24]   Brown, D. M. (16, June 29). Collaboration & Creativity: Getting into the Right Mindset [Web log post]. Retrieved January 15, 2017, from

https://medium.com/eightshapes-llc/collaboration-creativity-getting-into-the-right-mindset-b9d5d6eaf9f6

SUMMARY OF BROAD SCAN FIELDS OF RESEARCH

It is possible that the typical (and tenuous) business model for creating Informal Science Exhibitions could be disrupted by a new model that combines crowd funding, crowd sourcing of expertise, use of advanced remote collaboration tools and the construction of a platform shared by a community.

This model has potential advantages in connecting a global community of Science Centres with common interests and scare resources to co-create and share content at reduced cost and higher quality.

A successful co-creation platform for exhibition development would have to support the broad range of research and design methods, techniques and processes involved. Some of these approaches would need to be evolved for the proposed medium.

Perhaps the biggest challenge is creating a platform that supports the necessary collaboration at distance. An in-depth understanding of remote collaboration is critical to setting the design and operational criteria for such a platform. **Chapter 3** will focus on the in-depth research I undertook to explore the current state and potential of remote collaboration.

CHAPTER 3   IN-DEPTH RESEARCH
EXPERT INTERVIEW FINDINGS

In **Chapter 2**, I identified that an understanding of remote collaboration was a critical factor in the development of successful co-creation platforms. My next phase of research was to build further understanding in this area.

PROCESS

Through literature review, academic contacts and an open call on a list serve, I identified seven expert users involved in remote collaboration. This diverse group consisted of three women and four men ranging in age from their 30's to 50's with 10 to 20 years of experience in the field. Four experts were from multinational companies, one from a remote collaboration platform, one was an international NGO consultant and one was the principal in a small private UX consultancy.

Experts, through an interview process, were engaged in discussion that explored the following areas:

- Anecdotal experiences with remote collaboration and how it has evolved over the last decade.

- The key factors, competencies and values required for successful collaboration.

- Methods of and best practices for remote collaboration.

- Identification of platforms used and their strengths and weaknesses.

- What are the primary advantages of using a remote collaboration platform?

- What are the key drawbacks of current remote collaboration platforms and methodologies? How are those drawbacks mitigated?

Appendix G "Research Questionnaire" provides the interview protocol for the expert interviews. Notes were taken and interview recordings were transcribed. These were examined for key statements and opinions.

I have to note that the process of talking to a variety of experts was interesting in itself. Some of my experts were so integrated into remote collaboration they might be referred to as extreme users. By engaging experts with questions and listening carefully to parse answers and probe further, I sometimes heard experts explore new ways of considering their own subject matter. One could say this was also a form of co-creation. I also found inspiration in the replies, making connections to previous experience and knowledge. It was

also natural to brainstorm ideas to address problems put forward. Some of these ideas are shared in **Appendix G – Inspirations and Innovations**.

This section reports the key findings from expert interviews.

Appendix E - Detailed Findings from Remote Collaboration Expert Interviews provides additional details, explanation of terms and additional expert comments to provide readers more in-depth understanding of these points.

On the whole, my experts concurred that engaging in remote work is a given now for increasingly distributed multinational organizations.

Methodologies are evolving and current methodologies have distinct advantages and disadvantages. The trajectory is that remote work and remote collaboration will continue to increase both in prevalence, productivity and success.

> *"When dealing with large companies, there is no such thing as a project that at some point doesn't have a remote member. This is the nature of the business these days and I don't see that going away. Companies are getting more and more distributed. That is a current trend." Expert #2*

In-person collaboration and remote collaboration have many common requirements.

- Each approach has strengths and weaknesses in their processes that determine suitability for different types of collaborators, projects and design problems.

- An awareness of these strengths and weaknesses is important and can provide an opportunity for improvements in each approach.

- As technology advances, melding approaches will evolve a more successful hybrid.

Main drawbacks of remote collaboration

Despite the fact that the majority of experts advocated the necessity and advantages of remote collaboration in their fields of work, they were clear that drawbacks remain. These drawbacks were important to be cognizant of and required attention in order to mitigate pitfalls that reduced the larger benefits of remote collaboration. Primary drawbacks include:

- Loss of the in-person social and physical connection

- Reduction of interpersonal communication and interaction cues

- Inability to interact with physical artifacts

- Lack of buffer between work and home life

Humans, as evolutionarily tribal and social beings, inherently develop group cultures through their interactions. Successful team cultural development can be hampered by the above drawback and requires special attention to overcome.

Expert 3 speaks about the challenges of moving beyond an interaction where:

"…I show you something and you comment on it…." Expert 3

The typical example of this would be emailing a document to a group of people for feedback.

"The challenge was how do you go from a one person sharing to one other, or one person to many, to a shared canvas and possibly many to many…"

"We used to talk about collaboration at a time when we were really just talking about conferring…which is so different than actually making something together…and maybe that is co-creating…" Expert 3

I found Expert 3's expression of the difference between modes of sharing important to reflect on. Figure 7 visualizes the spectrum from conferring to co-creating in terms of these modes of sharing.
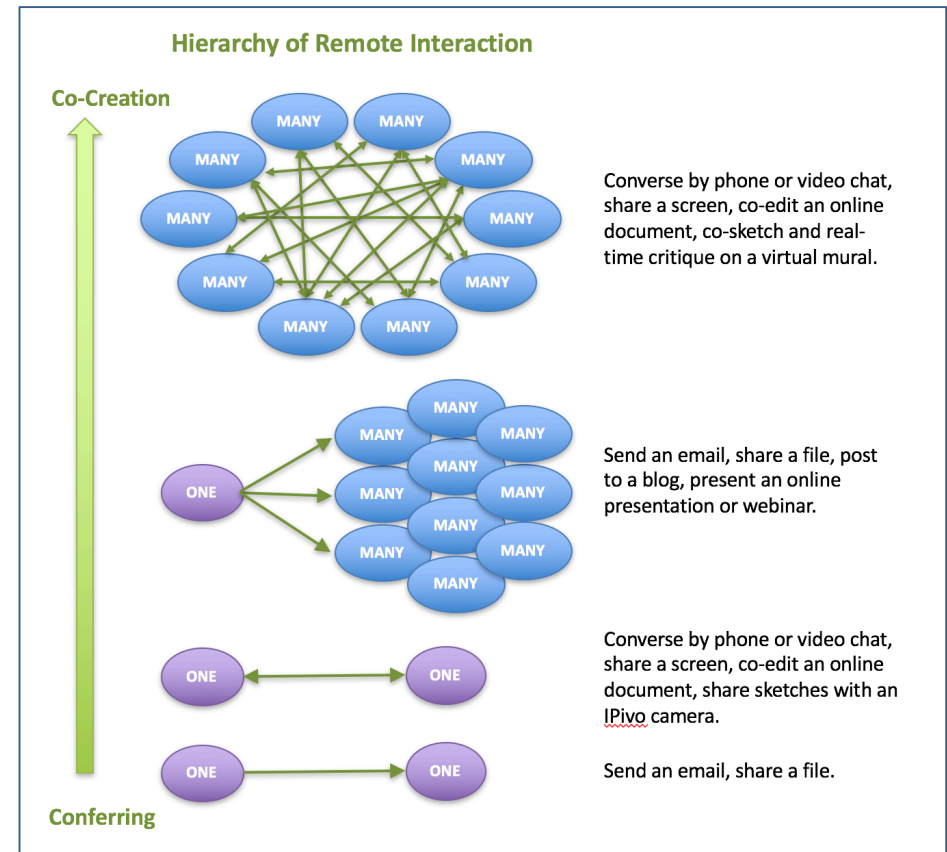
Figure 7 - Hierarchy of Remote Interaction – This visualizes Expert 3's notion of different modes of interaction from 'One to one' to 'one to many' and then to 'many to many.'

Main advantages of remote collaboration

Despite the drawbacks noted earlier, my expert proponents of remote collaboration pointed to numerous advantages that outweigh the adjustments required for working remotely. These advantages include:

- Access to experts anywhere in the world
- Access to more expertise on an 'as needed basis'
- Reduced or eliminated commute time
- Improved lifestyle
- More culturally diverse teams
- Enhanced concurrent multitasking
- Real-time sharing of information

In looking at the advantages and disadvantages of remote collaboration, there seemed to be a common theme. The success of remote collaboration depended on making adjustments to you and your team's behaviors to account for the differences to in-person collaboration and the social conventions that make in-person collaboration successful.

Key factors in successful remote collaboration

As I listened to the opinions and recommendations of these experts, I realized that remote collaboration is not for everyone.

In fact, in some circumstances it can be quite difficult and unsuccessful. In parsing the conversations, it was possible to identify factors that led to more successful remote collaboration.

These success factors include:

- Shared sense of vision, purpose and goals
- In person kick-off meetings
- Build on line personas
- Understanding of online personalities
- Virtual check-ins
- Investment in technological infrastructure
- Culture of equality and "agency"
- Transparency - working in the open
- Open Critique
- Role definition

- Onboarding process

- Diversity of discipline, thinking and cultural perspective

- Good housekeeping (process and document management) and planning

- Assign independent work where feasible and task appropriate

- Build teams who have worked together, have common work styles and like working together

- Clear management and decision making

- Use technology to support communication, coordination and sharing of data

- Use a strong enough infrastructure (bandwidth)

- Building the right culture - trust, social comfort, cultural sensitivity, egalitarian participation

Remote collaboration is an acquired skill.

You get better at remote collaboration with practice. There are methodologies for how to be a good remote collaborator so it is important to help your team acquire these skills. This is a list of practices that support the development of remote collaboration skills.

- Have a really strong onboarding methodology

- Share a checklist of abilities

- Provide guidance on how to approach the experience

- Identify common pitfalls, typical experiences

- Provide tips to make it work, get the most out of it

- Provide standard set ups for desktops to save time

- Identify a tools list explaining purpose, pros and cons

- Provide simple rules of the road for everyone to be aware of

Requisite competencies, characteristics and preferred behaviours for remote teams

Some of the experts noted that there were competencies and characteristics they looked for in prospective employees or that were important to acquire to be a successful remote collaborator. These included:

- Shared Values
- Mutual understanding
- Flexibility
- Attention to communications
- Technical literacy
- Conceptual understanding of zooming in and out
- Mastery of the "Digitally Defined Workplace."
- Channel fluidity
- Multi-device literacy
- Flexibility in adopting new tools
- Assertiveness
- Self-awareness
- Empathy

Mastery of the "Digitally Defined Workplace." Expert 2 introduced me to this idea. In a real office, everything has its place: desk, file cabinet, meeting room, calendar / planning board, noticeboard, water cooler, copier, whiteboard, etc.… and everyone knows where they are and when and why to use them. The same is true for the virtual office and virtual collaborators need to have the same level of comfort with the tools and their uses.

Expert 2's version of the "Digitally Defined Workplace" includes:

- Real-time communication (phone and video conference)
- Chat (which can be real-time, but is more of a recorded sequential digital conversation)
- Formal communication like the memo and email
- Storage, repositories of shared common knowledge
- Planning and management - scheduling and coordination of meetings, tasks, resources (Outlook)
- Visual collaboration including the digital whiteboard, digital flipchart, and digital sticky note.

Expert 2 refers to **Channel fluidity** as the ability to bounce between different platforms using the right platform for best purpose.

Values important to successful remote teams

Shared Values have been noted as an important behaviour for remote teams. Experts noted a specific set of values they promoted.

- Trust, Passion, Commitment, Willingness.

- Respect for the value diversity of opinions.

- Respect for the value of listening. This is both having the patience to listen as well as valuing the action of listening by others.

- Respect for Dissent - Embrace dissent and look for underlying issues.

- Appreciation for collective wisdom.

- Transparency.

- Sensitivity to inclusivity.

Methods and processes that make remote teams more successful

During the interviews, experts shared their tips for methods and processes that help make remote teamwork more successful.

- An **Idea Bin** can be used as a central repository for contribution of ideas by a larger collective.

- A **Parking Lot** can be used to hold ideas that may not be relevant to the task at hand.

- Use **Silent Time** for individual work during group sessions.

- Use **Retrospectives** for concurrent evaluation of processes.

- **Version Control** captures iterations of generative work.

- Cloud based **in-document commenting** provides discussion and critique in the source document.

- Use a speaker phone or even better, **a head set** so your hands are free to work.

Advantages of remote collaboration platforms

There are now hundreds of online platforms that support remote collaboration. These platforms can provide many distinct advantages to teams and communities working at a distance.

- Global access
- Direct to digital information capture
- Portable, archive-able, distributable, copy-able and sharable work product
- Traceability - inherently traces threads, tracks evolution
- Database storage of all captured data, artifacts, processes, discussion, work product
- Annotation, commenting and feedback processes
- Real-time sharing of information
- Concurrency of idea development
- Multi-task and engage more people
- Version control and information archiving

Drawbacks of remote collaboration platforms

As with remote collaboration, the enabling platforms also have some common disadvantages. These include:

- Require organizational investment
- Loss of typical forms of team spontaneity
- Impediment to live sketching inherent to in-person studio
- Loss of access to physical artifacts
- Requires cultural and personal change
- Point of diminishing return for large teams
- Trade-off in visual "real-estate" between the shared work and personal interaction (face video.)

When considering the whole question about working at distance, it is useful to consider the Allen Curve[25], a graphical representation in communication theory that reveals the exponential drop in frequency of communication between engineers as the distance between them increases. Expert 2 noted:

> *"…when your colleagues are 200 m away your frequency of communication is about the same as if they were remote. It is not uncommon for people comfortable with remote collaboration to have an email or video chat with someone on the floor right above them. This allows you to get several people together quite quickly or two people in one building and others elsewhere.*
> *If I go upstairs and have a chat with someone, then the other people don't have the benefit of that information, but if I do it in a Slack[26] channel or an email or a MURAL, then everybody benefits." Expert 2*

Figure 8 illustrates the Allen curve.
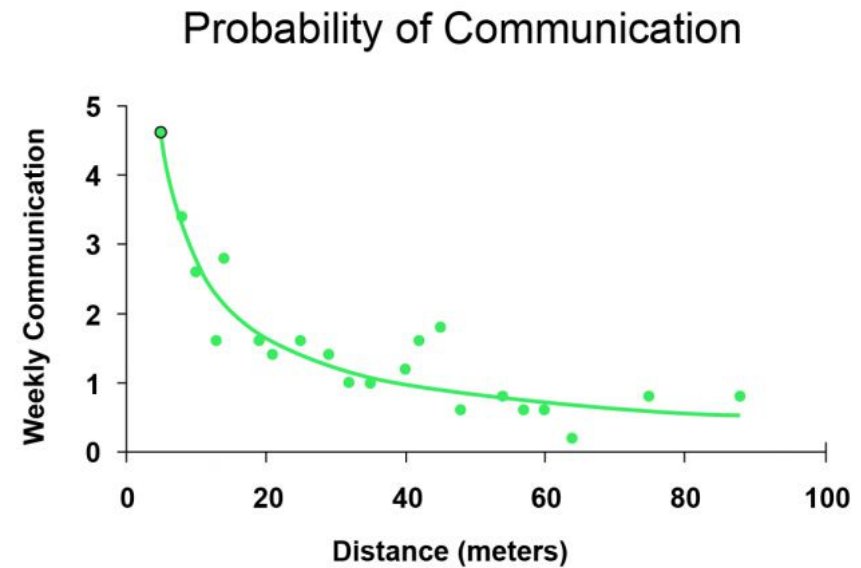
Figure 8 - The Allen Curve. Frequency of communications decreases exponentially with distance. http://www.henn.com/en/research/organisational-structure

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[25] Allen curve. (2017, February 14). Retrieved February 14, 2017, from https://en.wikipedia.org/wiki/Allen_curve

[26] www.Slack.com is an internet based instant messaging and document sharing platform that works on computers and mobile devices.

Pros and cons of building a single platform

Expert 3 noted that over the course of a project, the team changes, the needs change and the tools required change. A mashup of tools essentially becomes a suite. To help remote teams succeed, a checklist of tools was provided as well as templates for where to put platform components on the screen. Providing a pre-considered "designed" solution saved team members time and provided consistency.

Expert 7 suggests not being married to a specific set of remote collaboration tools.

> *"The problem that I see with an integrated platform is that every industry and every team has a unique set of needs…a unique style how they want to do this work…*
> *Different solutions for doing calls, video calls, screen sharing, posting work, receiving comments on work…. like having all those different tools at my disposal because I can be deliberate about what I pick." Expert 7*

The tools are always evolving, so you want to follow the innovation of the best tools and **be flexible in adopting new tools**.

Counter to this might be the anxiety associated with constantly changing tools and the potential complexity and loss of productivity associated with each new learning curve. From a human perspective, where does proficiency and productivity in a set of integrated tools

trump the complexity of changing to the latest non-integrated innovation?

Figure 9 illustrates the system influences underlying the debate for use of integrated or non-integrated functionality within a theoretical platform. At what point does the integration become so complex that it isn't feasible?
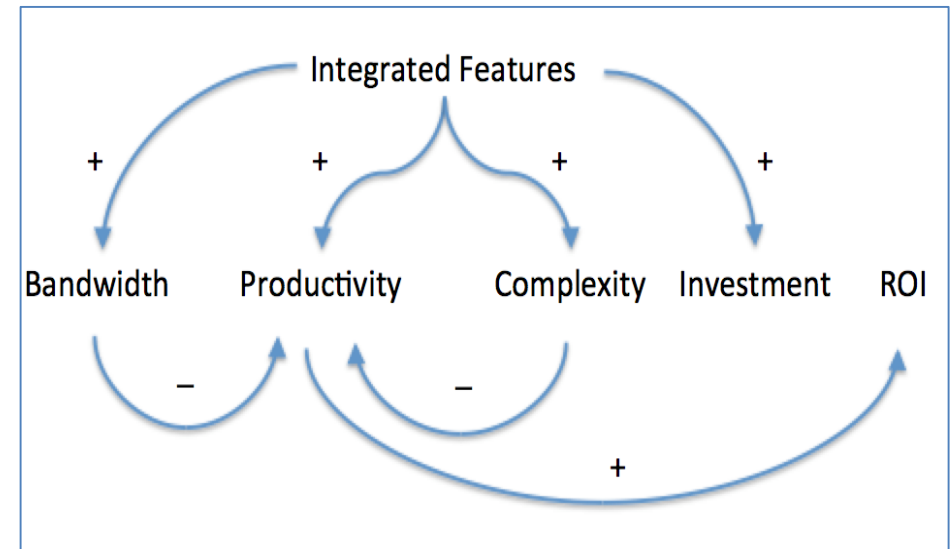
Figure 9 - System Map examining relationship of adding features to an integrated platform and the ROI.

Figure 10 postulates that at some point added complexity will negate productivity benefits of additional features.
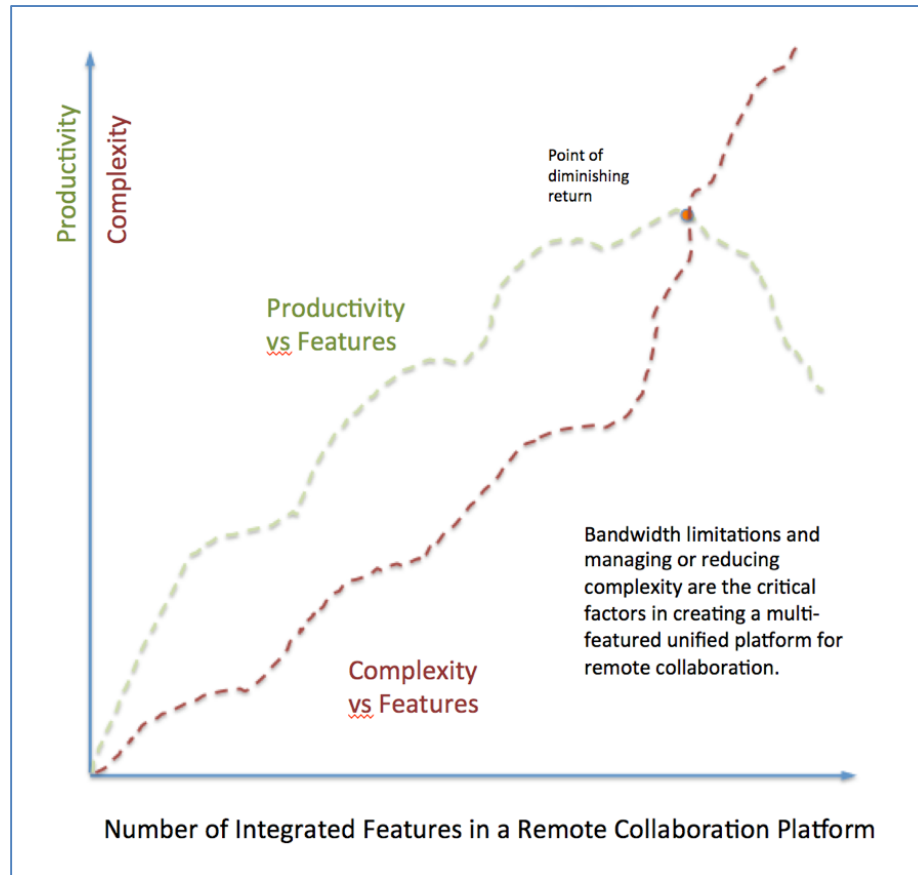
Figure 10 - This graph postulates the relationship between increasing integrated features and the resulting productivity and complexity. Discovering if these lines actually intersect would take additional research.

Expert 4 conveyed the experience of trying to pull together a large global, multi-cultural team of collaborators. LinkedIn, Dropbox, Skype and email were combined to create a shared platform. Expert 4 noted that there was a reluctance by some to adopt LinkedIn either because it required a significant investment to adopt, or because it connected to other aspects of their profession.

In the context of creating a platform for a specific development function targeting a broad user group (as will be proposed later,) I would suggest that the platform design follow two considerations:

1. Include enough integrated components to provide a consistent and planned environment for core and day to day processes and activities suited to the needs of the work to be done.

2. Make use of highly specialized platforms where the cost or complexity of integration is prohibitive. An example of this might be a crowdfunding component where not everyone on a team needs to be engaged daily and well refined options like Kickstarter.com and Indegogo.com exist.

CHAPTER 4   SURVEY OF REMOTE COLLABORATION TOOLS AND PLATFORMS

In the interviews I conducted, I asked experts about the remote collaboration platforms they used. This process generated an initial list of tools and platforms that served different functions required for remote collaboration. I chose to develop this list through on-line research to further understand the breadth and capabilities of the constantly expanding products available.

TOOLS FOR REMOTE COLLABORATION

The charts in Appendix F '*Assessment of Cloud based platforms, applications and tools for Remote Collaboration*' categorize a non-exhaustive range of available tools as of July 13, 2017. These tools are rapidly changing, either in adding or losing functionality depending on response to a highly competitive market and the trend for functional integrations.

Building on the work of the Olsens, *Figure 6 – 'Classification of technologies to support distance work'* **(***J. Olson, G. Olson, 2016),* each

platform was assessed for functionality and primary purpose. Although many systems overlap in purpose, they tend to have a primary purpose that they were built or initially intended for.

Analysis and grouping of these two dimensions revealed a further iteration of categorization for Remote Collaboration Platforms and their functionality.

CATAGORIES OF FUNCTIONALITY FOR REMOTE COLLABORATION TOOLS

❑ **Generative** – tools that enable or capture work product like documents, whiteboards and sketching

❑ **Communication** – facilitate multi-channel communication between remote workers

❑ **Coordination** – work process, tracking and management tools

❑ **Information Repositories** – the method by which information is shared and stored.

❑ **Infrastructure** – System architecture such as a website, security systems, search systems and analytics such as AI processing of information.

CATAGORIES OF REMOTE COLLABORATION PLATFORMS

❑ **Communities of Practice and Affinity Spaces**

A Community of Practice is a site or platform where members share documents such as advice, case studies, reviews, best practices. This is generally done one-to-many in blog or post form.

Example: ExhibitFiles.org

Affinity Spaces are similar to Communities of Practice, but have more generative interactions between participants and new content is likely to be created or evolved collaboratively.

Examples: Reddit.com, Yelp.ca

❑ **Project Document Sharing / Information Repositories**

Web-based apps like GoogleApps that allow co-editing of documents, spreadsheets and slide decks can be used as rudimentary collaboration platforms in conjunction with cloud-based file storage.

Examples: Google Drive (www.google.com/drive/), DropBox.com, Box.com

❑ **Communication Applications**

Communication tools allow team members to interact and discuss through video, phone, VOIP, chat, blog, instant message, email and document commenting.

Examples: Skype.com, Zoom.com, Slack.com,

- ❏ **Project Management and Knowledge Sharing**

   Some platforms focus on combining sharing documents, communications and project organization which include checklists and to do functions.

   Examples: Trelleo.com, ZenHub.com, Padlet.com, Redbooth.com

- ❏ **Integrated Enterprise Systems**

   An enterprise system integrates a complete range of collaboration tool functionality. These can be purposed for the varied needs of many different companies and organizations.

   Example: Microsoft Office 365

- ❏ **Design / Visual Co-creation Platforms**

   An on-line platform that allows multiple users to work together in a visual way on virtual whiteboard.

   Examples: MURAL.co, Stormboard.com, ConceptBoard.com

- ❏ **Dedicated Co-creation Enterprise**

   A dedicated co-creation platform enables members to co-create within a framework towards a specific type of outcome.

Example: Quirky.com has built a co-creation platform for product development and implementation. Members put forward ideas for products or even completed designs. The community works together on-line to access and develop the concept through various stages, voting at key points. Members of the community gain a stake in the project through their contributions. The core team at Quirky takes successful projects through to market and even offer products for sale through the site. Each product tends to have a single owner of the idea.

Other Examples: Shapeways.com

- ❏ **Crowd Sourcing Enterprise**

   A crowd sourcing enterprise captures value from a community of participants who share ideas and information, discuss and comment. Shared information is often voted on and an aggregate value of the information is established.

   For example, Reddit.com is a bulletin board system where members 'up-vote' or 'down-vote' on posts so that the most popular posts move higher and get more exposure. Topics or discussions are broken down into over 11,400 'subreddits.'
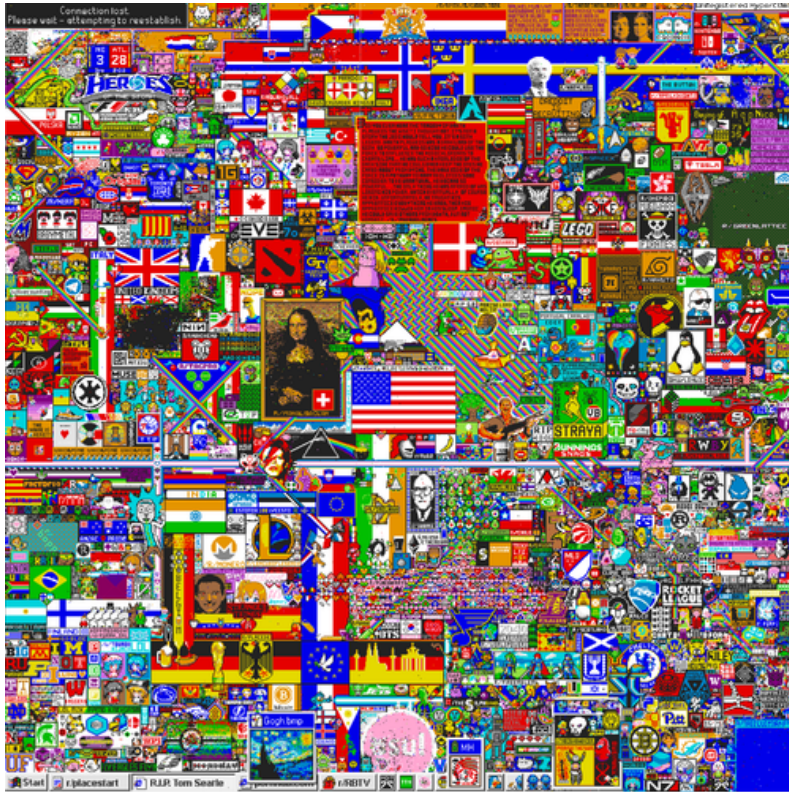
Figure 11 - The final "Place" canvas.
https://en.wikipedia.org/wiki/Place_(Reddit)

Some subreddits have wikis that provide additional instructions, recommended reading, or collaboration for real-life events.[27]

In 2017, Reddit sponsored an online canvas called "Place" (see Figure 11) which allowed over 1 million online collaborators to create a piece of art pixel-by-pixel within a set of defined rules.[28] This social experiment demonstrated how a global collective of collaborators could be willing to participate in social projects, that sub-groups will self-organize around mutual interests and that intergroup conflict and collaboration mimic real world experiences. Advancing technology is enabling novel ways to create new global communities and access untapped potential.

Zooniverse.org is another kind of crowd-sourcing enterprise – *"People-powered research."*[29] Zooniverse invites volunteer citizens to participate in research projects to parse small portions of large data sets that would be otherwise unaffordable to do.

[27] Reddit. (2017, July 23). Retrieved July 24, 2017, from https://en.wikipedia.org/wiki/Reddit
[28] https://en.wikipedia.org/wiki/Place_(Reddit)
[29] Zooniverse. (n.d.). Retrieved August 02, 2017, from https://www.zooniverse.org

"Back Yard Worlds – Planet 9" is a good example of one Zooniverse project. Scientists know there is a brown dwarf that is theoretically orbiting our outer solar system beyond the outer reaches of Pluto.

Finding it involves comparing matched consecutive sky field images for changes. Computers are not very good at identifying these differences, but humans are.

The sky is big, so there are millions of these images.

I contributed 3 hours of scanning, learned about astronomy research and brown dwarfs, and even identified some anomalies.

40 thousand other people volunteered...and together have identified at least 13 new brown dwarf candidates.[30]

I participated because of my interest in space and I became engaged in the experience of scientific discovery.

Maybe I might find Planet 9.

❑ **Idea & innovation management software**

This category focuses on encouraging and managing crowdsourced idea generation and development, often including features such as proposals, ranking, creator tracking, project gating and reward features.

Spigit.com is an innovation management platform that enables crowdsourced idea generation from the employees, partners and customers. Spigit uses crowd inputs, data science and algorithms to predict and advance the best ideas. Checks and methodologies counter-act herd behavior, an important consideration when considering crowdsourcing and evaluation of ideas.

Other Examples: www.Betterific.com, www.oiengine.com, http://crowdicity.com, http://www.brightidea.com

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[30] Zooniverse. (n.d.). Retrieved August 02, 2017, from https://www.zooniverse.org/projects/marckuchner/backyard-worlds-planet-9

Team rLoop is an inspirational example of on-line distributed team success involving hundreds of participants from many disciplines located in 14 countries around the world.

The team was born out of a post on the SpaceX subreddit (https://www.reddit.com/r/spacex/) that suggested the community might put together a team to compete in the SpaceX sponsored Hyperloop Pod Competition.

The post is shown in Figure 12. Note the early suggestions for GitHub, community and crowdfunding. The posts also suggest excitement, commitment and "aliveness" which we know are characteristics typical of Affinity Spaces.

The idea took off and grew a global team of volunteers. [31]

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[31] Wiltz, C. (2017, April 24). Keeping in the Hyperloop: Building a Faster Future. Retrieved July 29, 2017, from https://www.designnews.com/aerospace/keeping-hyperloop-building-faster-future/165914113956599/page/0/4?cid=nl.x.dn14. edt.aud.dn.20170419.tst004t
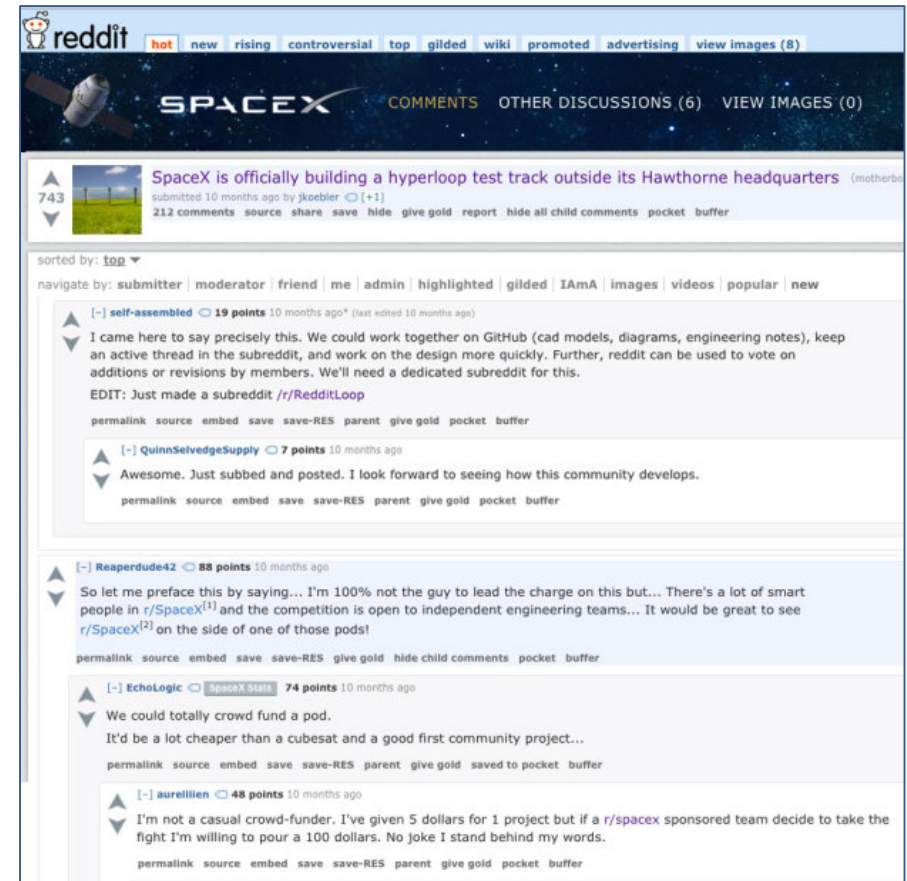
Figure 12 - Screen capture from rLoop's Indiegogo page showing the series of reddit posts that started rLoop. Note the early suggestions for GitHub, community and crowdfunding. The posts suggest excitement, commitment and "aliveness." https://www.indiegogo.com/projects/help-build-rloop-s-pod-for-spacex-hyperloop-comp#/

From rLoops' Facebook page:

"rLoop is a non-profit, open source, online think tank. Our goal is to democratize the Hyperloop by embracing open source and collaborative design and development. Since our founding, more than 140 members from over 14 countries have rallied behind this concept. rLoop is the only non-student team remaining in the Hyperloop competition. Together we are revolutionizing transportation, and our approach to realizing it is just as revolutionary."[32]

rLoop's "Welcome to rLoop" page lays out the framework for this co-creation team with answers to these questions:

- *Who is rLoop?*
- *What is the goal of rLoop?*
- *How exactly can you help?*
- *Where should you get started?*
- *Core Values:*
- *Team Leaders:[33]*

…and invites members with ***"Let's get to work!"***

The team of volunteers collaborated using their own sub-reddit, and collaboration software like Skype, Slack, Facebook, LinkedIn, Trello, GitHub, Google Drive, DropBox, Hangouts and Fusion 360.[34]
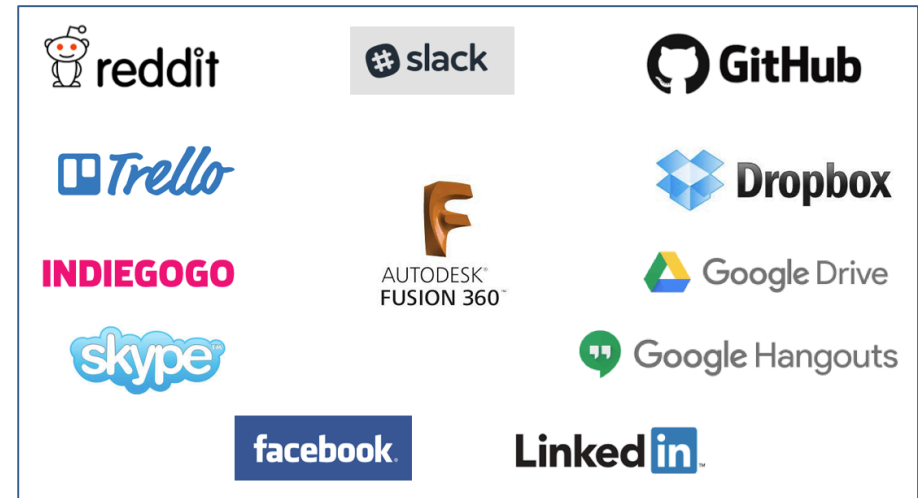
Figure 13 – This represents the on-line collaboration tools rLoop combined to create their own remote collaboration platform.

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[32] Welcome to rLoop! • r/rLoop. (n.d.). Retrieved July 29, 2017, from https://www.reddit.com/r/rLoop/comments/3ggl96/welcome_to_rloop/
[33] beltenebros. (2015, August 10). Welcome to rLoop! • r/rLoop. Retrieved July 30, 2017, from https://www.reddit.com/r/rLoop/comments/3ggl96/welcome_to_rloop/

[34] Exploring the rLoop Hyperloop Project: the Power of Crowdfunded Engineering. (2016, March 22). Retrieved July 30, 2017, from https://www.youtube.com/watch?v=iK88HXjSqDk

rLoop's work eventually attracted the attention of a sensor and connectors company, TE Connectivity. The company became the lead sponsor for the project, provided space for prototyping and testing as well as additional technical expertise."[35]

Through sponsorship that included at least 13 companies[36], as well as **$64,887** USD raised through crowd-funding on Indiegogo,[37] the team funded the production of prototype they designed together on-line.

The team became the only non-student, non-university sponsored team in the competition, and succeeded in creating a prototype that won a Pod Innovation award at Phase I of the competition in January 2017 and is moving forward to Phase II of the competition.

Figure 14 - Co-Created Hyperloop Pod Schematic (image source: rLoop https://www.youtube.com/watch?v=Z06iy1Uc65A)

Figure 15 - Hyperloop pod created by Team rLoop for the SpaceX Hyperloop Pod Competition. (Image source: rLoop)

[35] Wiltz, C. (2017, April 24). Keeping in the Hyperloop: Building a Faster Future. Retrieved July 29, 2017, from https://www.designnews.com/aerospace/keeping-hyperloop-building-faster-future/165914113956599/page/0/4?cid=nl.x.dn14. edt.aud.dn.20170419.tst004t

[36]Imagine... (n.d.). Retrieved July 29, 2017, from http://www.rloop.org/#/sponsors

[37] Lessard, B. (2016, March 07). Help Build rLoop's Pod for SpaceX Hyperloop Comp. Retrieved July 29, 2017, from https://www.indiegogo.com/projects/help-build-rloop-s-pod-for-spacex-hyperloop-comp#/

In a talk about his experience with rLoop, Lead Engineer Tom Lambert, shared key principles he believed were important to make Crowdsourced Engineering work:

❑ *Communication – the most important thing is making sure everyone knows what is going on.*

❑ *Rigorous organized documentation – if someone does something, capture it and catalogue it.*

❑ *Be objective driven.*

❑ *Break the work down into micro-components.*

❑ *Maintain motivation and approval.*

❑ *Keep a tight ship and have a clear idea of the direction (because people get distracted.)*

❑ *You can use the crowd to vote on decisions, but sometimes educated executive decisions have to be made.*

❑ *Care for the newcomers to help them be productive. This includes the support of a Human Resources function integrated into the on-line team.*

❑ *Help people prioritize.*

❑ *Be flexible, accept criticism and be prepared to take a step back from time to time.*

❑ *Always have a backup plan and backup resources. In crowd sourcing people may come in, do amazing work for a couple weeks and then need to go. This of course is another reason for rigorous documentation[38]*

rLoop exemplifies the potential of the crowd to create. Clues to their success are found on their LinkedIn page:

> *"rLoop VALUES: OPEN INNOVATION - PASSION - RESPONSIBILITY …. rLoop believes in the power of open-source collaboration. It's the driving ethos, the catalyst for innovation, and the means to exponential growth. rLoop believes individuals can have a massive impact when their passion is their incentive, and when they know they are making a difference."[39]*

We know that **passion, shared values and common purpose** are critical to successful remote collaboration. Even using a cobbled together collection of existing on-line tools (including a Google form to vet collaborators and a Google sheet to post results of public comments), a team of remote volunteers were able to break down the

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[38] Exploring the rLoop Hyperloop Project: the Power of Crowdfunded Engineering. (2016, March 22). Retrieved July 30, 2017, from https://www.youtube.com/watch?v=iK88HXjSqDk

[39] Keep up with rLoop Incorporated. (n.d.). Retrieved July 29, 2017, from https://www.linkedin.com/company/rloop-incorporated

project requirements, develop a distributed process for the work and enable sub-teams and members to undertake the work.

This group of internet volunteers became one of 7 finalists out of over a thousand co-located university sponsored teams.

This is no small feat. They specified, designed and prototyped a highly engineered new form of transportation in a remarkably successful remote collaboration effort.

Their story contradicts some of the pre-conceived challenges of remote collaboration.

These enthusiasts had a lot of talent to start with…at least one NASA engineer… so they were able to build a methodology from their existing experience on the fly.

Imagine the potential for solving pressing global problems if a platform was designed and optimized to allow not just engineering and project management professionals, but everyday citizens easy access to creating teams and pre-developed processes for co-creative work in areas of common interest. **If such a platform were to come as ubiquitous as Facebook, it might change the future of how many people work and the potential of what they can produce.**
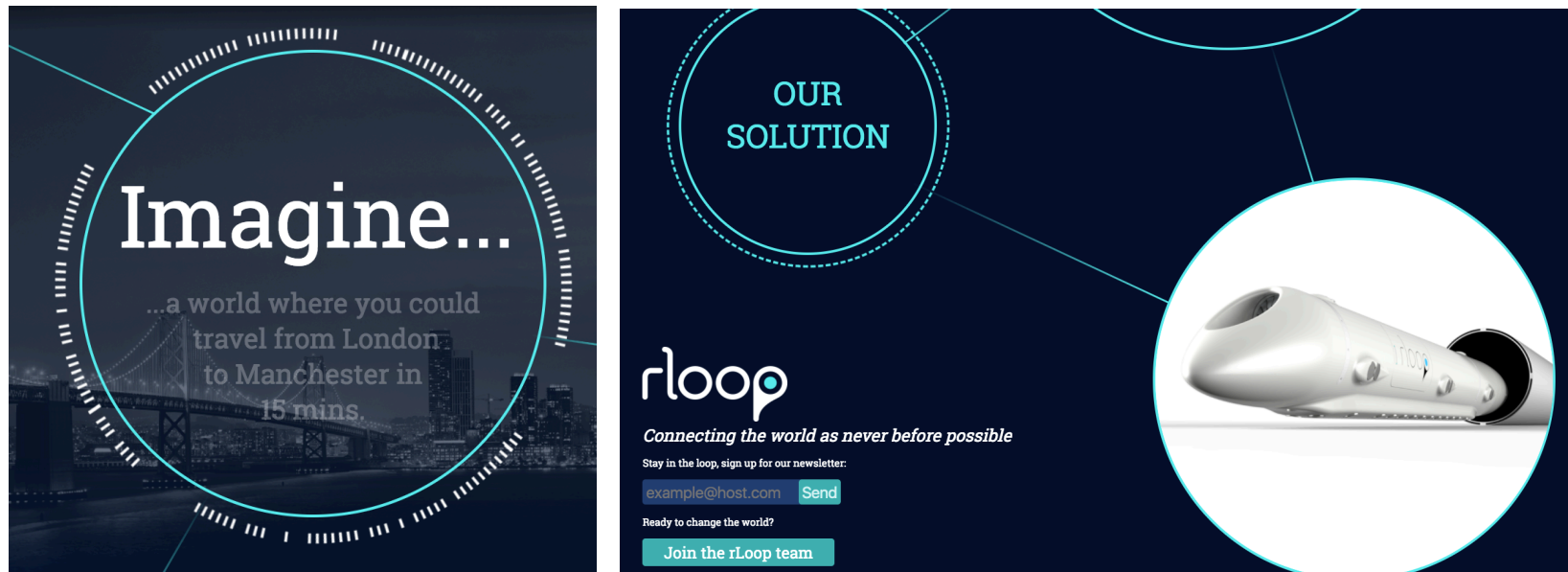
Figure 16 - Screen Captures from the rLoop.org website. http://www.rloop.org/#/home

CHAPTER 6 INSPIRATIONS AND POTENTIAL INNOVATIONS

This research project often felt like a large jigsaw puzzle. Sorting through the many puzzle pieces, some could be identified as individual problems to solve on their own. For example, one could identify that a weakness in the system of remote collaboration was the loss of in person communication cues...and wonder: How does one improve this important component?

Throughout my research, I kept an idea book to capture inspirations and potential innovations that would present themselves as my mind processed these problems in the background.

Appendix G - Inspirations and Innovations documents some of the innovation inspirations captured through the process of researching and evaluating different remote collaboration tools and methodologies. Some of these innovations laid the foundation for the possibility of a new type of platform for collaborative co-creation.

The technology for most of these ideas exist already and for the others the technology will soon come along. With each improvement in technology and increase in bandwidth, remote collaboration will move towards in person collaboration in terms of personal connection.

Our ability to identify and mitigate process challenges sets an inevitable trajectory for change in the way we work and learn and how we will take advantage of the potential of a globally connected population.

These conceptual innovations reinforced my belief that the remaining draw-backs of remote collaboration will eventually dissipate. As this happens, platforms such as the one I envision in the next chapter will become completely realizable.
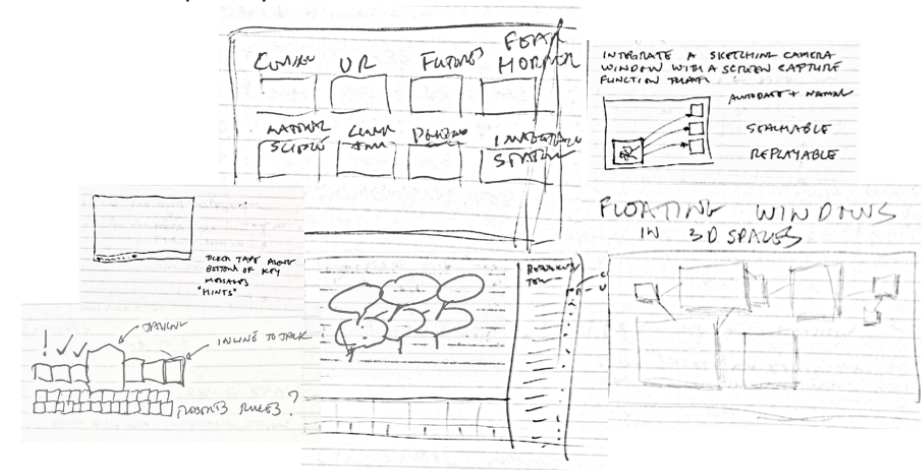
Figure 17- A selection of sketches from my idea book

CHAPTER 7   SYNTHESIS OF FINDINGS

SUMMARY OF FINDINGS

1) Impactful Trends

After considering the body of research conducted, I find the following elements important to consider in searching for a new Informal Science Learning model:

- Crowdsourcing
- Crowdfunding
- Virtual Prototyping
- Virtual Reality / Augmented Reality / Mixed Reality
- Online collaboration methods
- Co-Creation Platforms
- On-line Communities of Practice and Affinity Spaces

This is a list of trends that all seem relevant to or have the potential to add value to the process of developing new learning experiences.

It is interesting to note that almost all of these elements were components of rLoop's success (see Chapter 5).

2) Experiences

Why did rLoop succeed? Why did these enthusiasts volunteer thousands of hours?

The people who got involved with rLoop wanted the experience of being part of creating, learning, connecting, competing and achieving. The thousands for Zooniverse participants searching for Planet 9 (as discussed in Chapter 4) volunteer their time analyzing data in exchange for the experience of learning and the opportunity for discovery.

The idea that humans seek and value experiences is not new. The fact that on-line platforms can now commoditized experiences in exchange for volunteer time or other value as part of a business model is certainly interesting.

With this in mind, a critical trend to add for consideration for improving Informal Science Learning is:

"Experiences" as a Commodity

3) impact of remote collaboration tools

The other important finding was the extent of advancement and impact of remote collaboration tools.

Again, looking at rLoop, we can ask the question "Is rLoop's success as a distributed self-assembling remote working team an anomaly, or have the tools and technology hit a tipping point and this is just the beginning?"

Drawing from existing professional collaboration experience, team rLoop used existing readily available tools to assemble a global team, communicate, promote, manage code and tasks, share files, conference, promote, fund and engineer.

This group of internet volunteers became one of 7 finalists out of over a thousand co-located university sponsored teams.

This is no small feat. They specified, designed and prototyped a highly engineered new form of transportation in a remarkably successful remote collaboration effort.

Imagine the potential for average citizens to start up their own projects, if there was a prepackaged platform that didn't require signing up for six different apps and had the process templates and guidance in place.

4) The power of platforms

One of the tools that contributed to rLoop's success, Indiegogo.com, is a good example of the power of a well-integrated platform that creates value by creating a framework to complete a task (raise funds) as well as connecting large numbers of people.

Indiegogo considers itself a "Launchpad"[40] to help enterprises raise funds, network/reach customers, promote and sell. And as the platform has evolved, they have added more components to help people succeed including access to expertise and access to investment.

It is a platform that has enabled 650 thousand projects and has raised $1 billion in project funding.

Providing a platform enables people to create and co-create and as a result produce more shared value.

Internet enabled "platform" based co-creation is exploding…
…and the resultant amplification of global creativity will be a force in our shared future.

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[40] *Indiegogo is a launchpad for entrepreneurial ideas.* (n.d.) Retrieved July 29, 2017, from https://www.indiegogo.com/

Three things to consider:

1. We know there is a desire for experiences.

2. The internet is a great conduit to excess human capacity.

3. Providing a platform enables people to create and co-create and as a result produce more shared value.

Here is an equation that captures the relationship between these three elements:

Human desire for experiences

+ Excess human capacity

+ Platform that enables creativity

= Shared Co-Created Value

From this equation, I hypothesize two concepts:

Providing platforms that enable people to create their own experiences that they co-create and share with others amplifies Global Value Creation.

The future of Learning will be driven by the development of platforms that allow citizens to participate in the co-creation and sharing of learning experiences that they desire and connect to.

The research would suggest these three things.

Culture, Process and Infrastructure
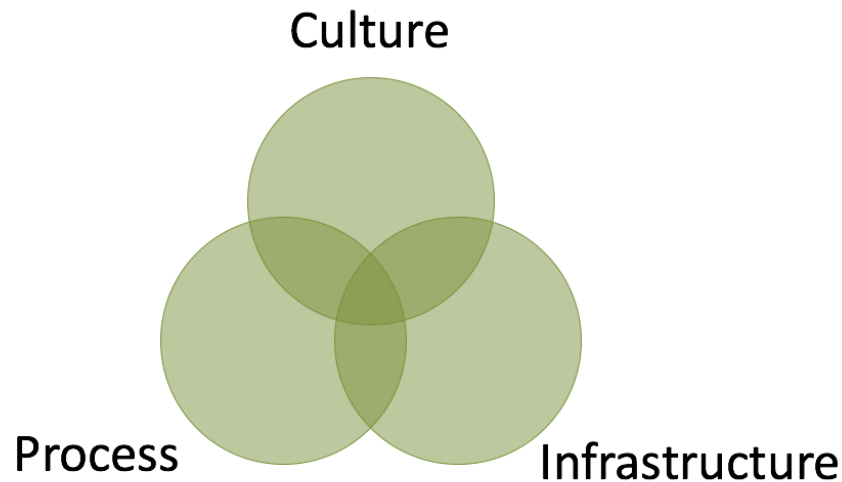
Figure 18 – Requirements for successful co-creation platforms.

rLoop already had the foundations of Culture in Reddit: a discussion community with debate and a democratic system of 'up-voting' and 'down-voting.'

The fact that they wanted to succeed and needed each other to complete this complex task would have also been an evolutionary force on the project culture.

They evolved their own set of collaboration processes (which were founded in project management and engineering management) and essentially prototyped the components of an infrastructure they could all use.

Fortunately for this group, they collectively, at the outset had the capabilities to implement this self-assembled platform (infrastructure) to create the co-creation experience that they wanted.

Not everyone has this ability, which leads to two important questions:

What kind of platform would the rest of us need?

How could this platform be used to create a new and improved way of providing informal science learning?

I will propose an innovation to answer these two questions next.

PROPOSED INNOVATION

I envision a platform that brings together the product development qualities of Quirky, the enabling qualities of Indiegogo, the crowdsource, learning and experience qualities of Zooniverse and the collaboration and cultural qualities of the improvised remote co-creation platform used by rLoop to create a Problem-Solving Platform that enables crowd-based self-assembling teams to succeed at solving the problems they want to solve.

📑 The case for a Problem-Solving Platform

Imagine the potential for average citizens to start up their own problem-solving projects with other like-minded individuals with a common interest or passion. Such a platform could capitalize on excess human capacity, collective desire to change and improve our world and desire to be part of a successful community.

There is the potential to evolve a globally accessible change incubator, a prepackaged platform that doesn't require signing up for six different apps. In the broadest sense, it would provide process templates and guidance to build a team to solve a problem.

A category missing on Ethority's Global Social Media Prism is a **Problem-Solving Platform that enables crowd-based self-assembling teams to succeed at solving the problems they want to solve.**
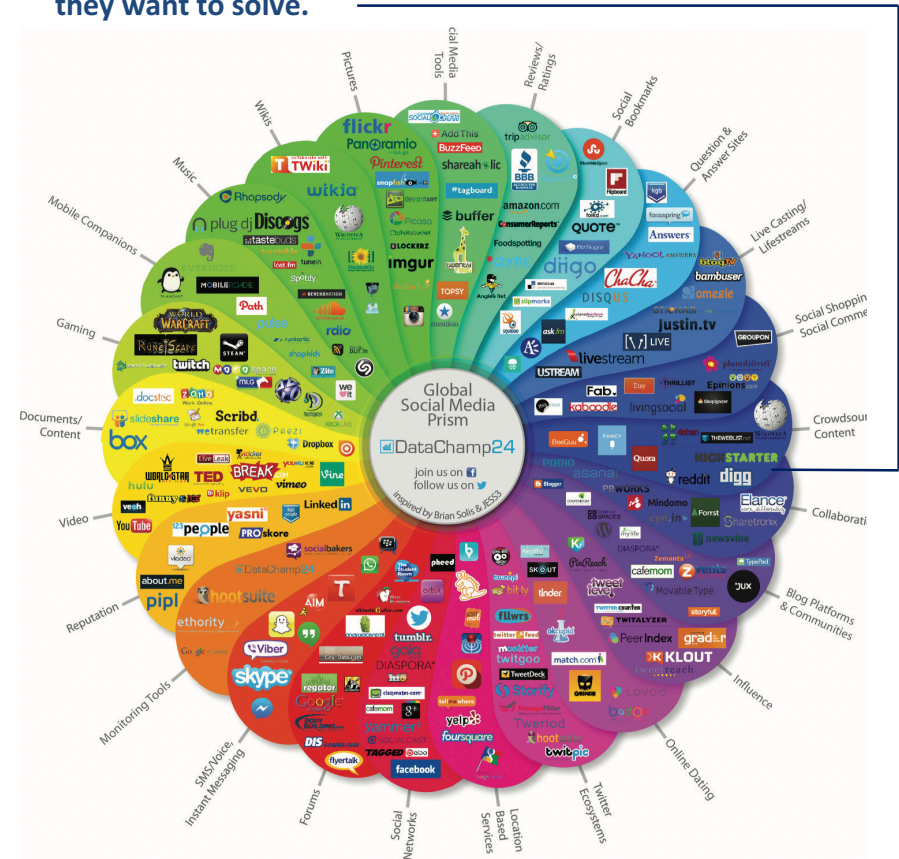
Figure 19 – Looking again at Ethority's Global Social Media Prism, we see that a problem-solving platform might fit neatly between Crowdsourced Content and Collaboration.   Ethority's Global Social Media Prism - Digital Landscape & Conversations. (n.d.). Retrieved July 29, 2017, from https://ethority.net/social-media-prism/

Proposed Framework for Remote Co-Creation Platform

Based on the research findings, Figure 20 is a platform framework I propose for engaging citizens in self-sustaining co-creation.

This framework indicates the requisite components required within the three primary requirements of Culture, Process and Infrastructure.

In a more focused context, an on-line platform with these features and functionalities could be used by educators and science enthusiasts to generate informal science learning experiences.

In **Appendix H though L**, I build out the next levels of this framework to illustrate how this innovation can be applied to a new model for developing informal science learning experiences.

Remote Co-Creation Platform Framework

Culture	Processes	Infrastructure
Community of Co-creators	Implementation Methodology - Roadmap	Shared Document Templates
Understanding of Mutual Prosperity Through Benefits of Co-creation and Diversity of Thought	Open, Curated and/or Subscribed Participation	Shared Document Repository
Shared Charter of Values	Individual Amorphous Contribution	Knowledge Management System
Open Egalitarian Sharing Transparent Diverse Inquisitive Tolerant Patient Critically Considered	Collective Evaluation (up/down voting)	Online Co-creation Spaces
	Structured Refinement	Voting / Ranking System
	Distributed Task Opportunities	Remote Meeting Templates
	Co-ordinated Work Sprints	Video Conferencing
	Expert Evaluation	Instant Messaging
Self-sustaining	Curated Guidance of Semi-Linear Development Activities	Project Dashboards
		Wiki-based Correspondence
		AI Analytics
		Option for Closed Proprietary Development

Figure 20 – Proposed Remote Co-Creation Platform Framework.

CHAPTER 8   CONCLUSIONS

ENGAGE THE CROWD

For small remote collaboration teams, there is the option to select a set of existing tools and build competencies in those tools as part of a prescribed work methodology.

However, in engaging the broader crowd, where skill levels and access to software packages may be a barrier and proficiencies will be varied, I suggest that an integrated platform designed to make contributions easy and intuitive will be more successful.

There still remain downsides to remote collaboration relative to in-person studio work. However, looking at the advancement of remote collaboration tools we are quickly approaching a tipping point where the unique advantages of direct-to-digital and crowd capabilities will overcome those downsides in terms of potential innovation results. The resulting platform will have a much broader impact as it will be able to be applied to many other types of design and innovation collaboration challenges.

In this ever-accelerating age of technological and social change, science-literacy for all citizens is critical. In the absence of government leadership and investment in providing the resources to adequately address society's science literacy, and other problem-solving needs, it may be up to the "crowd" to tap into these very technologies to ensure their fellow citizens an equal and beneficial footing in this world.

If we zoom out, we can see a new platform that enhances the ability of diverse thinking people from a global community to work together to solve problems and create solutions in areas of common interest. This can only benefit our common future.

OUTCOMES

Through this research, I have examined the existing state of science exhibition development methodologies and identified failure points. I have identified trends that are applicable to disrupting current methodologies most notably: co-creation, remote collaboration, crowdsourcing, crowdfunding, AI analytics and "experiences" as a commodity.

I have assembled a wealth of information and principles for those interested in improving collaboration and exploring remote collaboration.

Expanded categorization of remote collaboration platforms and functionalities have been identified.

A number of innovations that can potentially enhance remote collaboration success have been ideated.

Examples of platforms like Quirky.com and Shapeways.com for product development as well as Brightidea.com and Crowdcity.com for idea management and Zooniverse.com for crowdsourcing of research suggest that purpose-built platforms that capture the power of communities are excellent foundations for business model success.

My research proposes building a **remote collaboration platform** to enable the potential of globally-distributed, self-assembling teams, so that these teams may work together, co-creating solutions to the problems that matter to them. This can be achieved by combining the most appropriate and best qualities and features from the functionalities available to create an innovation ecosystem.

I have conceptualized a version of the proposed platform to address the unique aspects and needs of science exhibition development. The concept, ScienceExhibitionsCollaborative.com is defined and illustrated in **Appendices H to L**.

NEXT STEPS

The scan of remote collaboration technologies shows a significant spectrum of tools and functionalities. To address the requirements or 'best practice principles' of remote collaboration, some of the existing tools are expanding their integrations, but no platform does this in a way that encompasses a complete suite of tools and methodology as has been proposed here.

The results of this research project would suggest the next step would be to build a prototype platform.

Such a platform would take investment and commitment to test which combination of innovations would provide the most robust and sustainable platform.

Although the focus of my research has been through the lens of science exhibition design and creation, this type of platform could be used or modified to suit the needs of other design and problem-solving challenges.

This research also suggests that there is an important bigger picture with greater benefits to the broader field of design and innovation.

THE RISE OF DESIGN DEMOCRACY

One of the aspects I am so struck by is the incredible value that communities like rLoop can create, as volunteers, for free. This value is founded in human desire for accomplishment, learning, community, interaction, fairness, creating a better world and a share of or stake in the outcome.

As technology makes these interactions more readily available to everyone and particularly to the 'best of the best' in a global community, any company or government organization that continues to subscribe to old-style, top-down authoritarian management will be disrupted and left behind by the power and creativity of technology-driven, crowd-sourced design democracy.

Most importantly, the research concludes that technological advancements and successes in remote co-creation suggest an emergent model for the improved future of learning, work, productivity and the potential for the crowd to democratically self-assemble and engage in design and problem solving to co-create a better world.

Culture will eat Management for Lunch…

Imagine being able to learn and work at what you want,
from where you want,
when you want,
with who you want,
to accomplish what you believe in…

That sounds like a pretty good trajectory
for the future of learning or work…
…and perhaps that doesn't even sound like
what we define as work per se…

…so maybe it is the future of living.

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LIST OF APPENDICES

APPENDIX A – EVOLUTION OF SCIENCE CENTRE INTERACTION TYPOLOGIES

Excerpt from "Exploring Challenges and Opportunities for Informal Science Centres Through an SFI Lens" (Kasanda T. 2015)

Methods of interaction continue to evolve both with advancing technology and our understanding of learning styles and preferences. Below is a brief look at interaction typologies and terms as they have evolved over time.

Static:

Artifacts in cases, graphics panels

Figure 21 - Models and graphics can be informative if well presented. Photo: Ontario Science Centre. Toronto, ON.

Push-button:

Press a button to answer a question and receive a response. Press a button to activate a model.

Figure 22 - Press a button to make this exhibit throw up. Photo: T. Kasanda. Toronto. ON.

Audio-Visual:

Presenting content through a video or adding an audio track explanation to an artifact. Particularly useful in transporting a visitor to a setting they cannot reach.

Figure 23 - Little girl explains computer to grandmother. Photo: Ontario Science Centre. Toronto, ON.

Interactive:

Interaction with an exhibit involving stimulus and response / feedback to the user or where the experience evolves in response to the visitor's actions or choices over multiple iterations.

Hands-on:

Interaction specifically involving manual manipulation of interfaces such as puzzles, cranks, levers, dials. Also, the manipulation of objects such interesting artifacts (e.g. bones, skulls, historical objects) or

Figure 24 - Rotating Faces. Every turn creates a different expression. Photo: Ontario Science Centre. Toronto, ON

physical models that demonstrate a phenomenon or principle (e.g. pendulums, ball trajectories, wave patterns in water.)

Phenomenon based experiences:

Experiences where the interaction and "Ah Ha!" or 'What just happened?' moments are the result of a physical phenomenon. Examples include an air balloon rising as the air inside is heated, a heavy block can be moved when supported by a cushion of air, a feather falls to the ground just as fast as a ball bearing when dropped within a vacuum. Here ferrofluid conforms to the shape of a magnetic field because it contains nanoscale particles of iron.
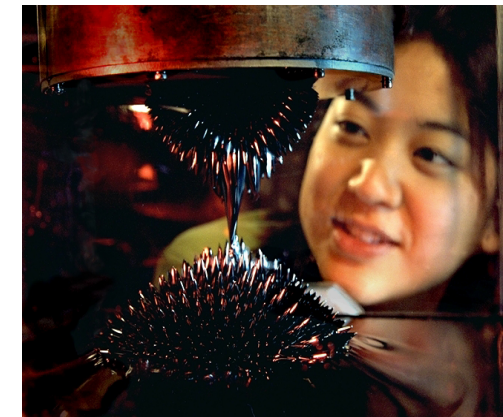
Figure 25 - What makes this liquid form spikes? Photo: Ontario Science Centre. Toronto, ON.

Participatory: Participation by visitors is inherent in the offered experience. It should be noted that some visitors will prefer to simply observe the interactions of others and gain satisfaction and learning if the experience is designed to allow for that observation.

Figure 26 - Flexibility Test.
Photo: Ontario Science Centre. Toronto, ON.

Object Theatre:

A three-dimensional manifestation of an audio-visual presentation where artifacts, props and moving models are integrated into a narrative staged

presentation. Theatrical effects, audio and video draw
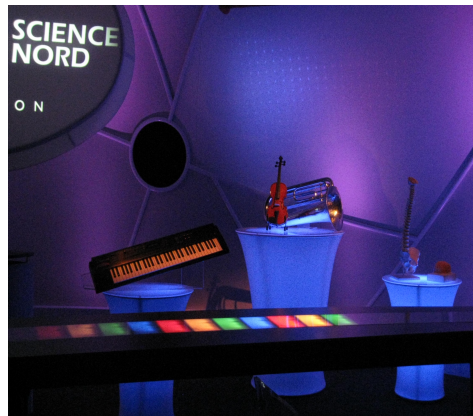
Figure 27 - Musical object theatre.
Photo: T. Kasanda. Toronto, ON.

the audience through a physical story. Sometimes a live 'animator' hosts the audience journey and may draw individuals into activities within the presentation. Originated in the 1980's by Tiazo Miyake while at Canada's Science North, this was the original immersive experience.

Bodies-on:

A term coined during the creation of an exhibition on Sport where the experiences involved full body participation such as climbing a wall, balancing on a beam or throwing a baseball and being cued to the science of one's physical movements.

Figure 28 - Balance exhibit in the Sport exhibition.
Photo: Ontario Science Centre. Toronto, ON.

Minds-on:

A term coined to re-emphasize the learning component of 'fun' or 'entertaining' interaction. A well-executed exhibit can "mess' with your mind in

Figure 29 - Hand-Eye Coordination exhibit at the Exploratorium. Photo: T. Kasanda. Toronto, ON.

the creation of a puzzling experience resulting in questions and inquiry thus

engaging the mind. For example, a special pair of glasses used in this exhibit can shift your vision several inches to the right making it difficult to throw a ball through a hoop, but after repeated attempts your brain/hand/eye coordination can adjust to again successfully sink a few baskets. When you remove the special glasses, you can see the hoop right in front of you, but when you throw the ball it misses the net completely, not going where you would expect. It is this secondary messing with your mind that really hits home the point that your brain is capable of recalibrating the inputs it receives in response to observations and outcomes.

Open ended:

Experiences that encourage exploration with multiple (even unlimited) potential outcomes often through engagement with a kit of parts in the attempt to solve a problem. Through iteration and observation of outcomes understanding is built. One of the best examples of this is a kit of rollercoaster components. Each combination of parts creates a different result of a more or less

Figure 30 - Build Your Own Coaster Exhibit Photo: T. Kasanda. Toronto, ON.

successful coaster. Each iteration or modification implemented by a visitor provides a comparison to the previous and an evaluation of the qualities of the parts in terms of use or conservation of energy. Through an activity largely perceived as play, intuitive learning is inevitable.

Citizen Science:

A movement that evolved in informal science centres in the 2000's to engage visitors in the "process of science' by participating in science research activities. Technically it is an old practice dating back to 'gentleman' or amateur scientists. Now sometimes referred to as "open science' or 'crowd-sourced science', examples include visitors participating in field research to report butterfly counts, spotting or counting of birds, even collection of spit samples for DNA research analysis.[41]

Figure 31 - Citizen volunteers learn about Mississippi River fish species. Photo Wisconsin Department of Natural Resources. Retrieved from https://www.flickr.com/photos/widnr/6629017669/in/photolist-b6Ms16-9aS4Gz-xaEGTG-VdrPbx-W7T5ar-aycygp-d53utG-wSQxrk-xaSxvj-fgdMtA-W7T532-6S9wZy-d53qzY-cwFTKG-W7T5dc-eViW4d-9ayaSa-b6Mv5B-V55HjQ-8D8aWW-SFHbSa-cy9gio-LjkUub-fuaAHX-p6vQv5-T8JTwQ-XykK4N-V8FEmE-JULWZj-dm46XG-UosiMA-49DRkC-SZSx3j-WiSe5u-LMRWfC-8D59uH-cKsCHw-ST8rZN-GXiwCE-Tm2LCQ-Top9hB-GtKRZJ-exxYt4-Siitrw-GpAq2m-6b6ku9-8D8bf5-SZSw9A-o6zhX1-8D88g5 https://creativecommons.org/licenses/by-nd/2.0/

Edutainment:

The blending of education and entertainment. Fortunately or unfortunately, depending on your perspective, 'Edutainment' has become a marketing buzzword. Every attraction competing for share of 'watch time' is looking to add an educational component or spin. There is little in the way of standards for the quality or depth of that educational component. In the same respect, informal science institutions are pressed to become more entertaining as the science learning appears to no longer be enough.

"Edutainment is morally authorized entertainment."[42]

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[41] Wikipedia. (2015). *Citizen science*.

https://en.wikipedia.org/wiki/Citizen_science.
[42] Protean Strategies. (2014) OSC Experience Audit Consolidated Report 05_12_14. Toronto, On. Ontario Science Centre.

Augmented Reality (AR):

A process of layering additional virtual content onto an artifact or experience. An example of this would be to use a moveable screen such as an IPad to inspect a physical object, a dinosaur skeleton for example, and be able to view the actual animal superimposed onto the skeleton, or view a diorama and have additional animated content

Figure 32 - The Royal Ontario Museum in Toronto launched its first AR experience as part of its "Ultimate Dinosaurs: Giants from Gondwana" exhibition. Visitors can hold up iPads to the giant dinosaur fossil casts and see what the beasts might have looked like in their full flesh. Photo: The Royal Ontario Museum. Toronto, ON. Retrieved from http://www.thestarphoenix.com/technology/futuretech/Augmented+reality+apps+turn+smartphones+into/6922894/story.html#ixzz3itosfBPz

appear when viewed through a device.

Immersive experience:

In the context of a science centre, an immersive experience might use a motion simulator to fly a visitor on an adventure though the human body using Computer-generated imagery (CGI). A visitor might also be theatrically immersed in a windstorm, or walk through a recreated environment like a rainforest. As technologies like Oculus Rift come to market it is likely they will also be used to create informal science learning experiences. The question one might ask is whether immersive / virtual technologies will be used to create unique experiences that drive traffic to science centres, or make it possible to have these unique experiences remotely without the need for a physical visit.

Figure 33 - Gear VR Headset. Photo: Samsung. Retrieved from www.Bestbuy.ca

APPENDIX B - METHODOLOGIES FOR CREATING ENGAGING EXPERIENCES

Excerpt from "Exploring Challenges and Opportunities for Informal Science Centres Through an SFI Lens" (Kasanda T. 2015)

Access to real stuff

...that is rare and unusual creates a starting point for an inquiry or a discussion.

How similar is your heart to that of an elephant?

Figure 34 - Elephant Heart
Photo: Ontario Science Centre. Toronto, ON.

Real experiences

A hot air balloon heated by an actual flame (as opposed to an electric heated fan) connects the inherent visual excitement of fire, the knowledge that it is hot, and the observation that the balloon above is expanding and starting to rise.

Figure 35 - Hot Air Balloon. Photo: T. Kasanda. Toronto, ON.

Entrance as a mechanism for setting a stage or context

A dramatic entrance experience or visual can set the stage or context for the experiences to follow. Being sorted builds anticipation and possibly discomfort before entering A Question of Truth, an exhibition where values and perceptions are challenged.

Figure 36 - Sorting: Entrance to the Question of Truth Exhibition
Photo: T. Kasanda, Toronto. ON

Playing with Scale

Changing the scale or presenting a real scale not normally seen can create a new point of reference or inquiry.

We might see a shopping cart full of groceries every week, but what about seeing a whole year's worth of shopping carts all at once… Astonishing how much food one eats in a year!

… or how much garbage we have buried!

Figure 37 - Garbage
Photo: T. Kasanda. Toronto, ON.

Figure 38 - Food for a Year
Photo: Ontario Science Centre. Toronto, ON.

Revealing Surprises

A fifteen-foot-tall, two ton ships propeller is certainly an unusual artifact that plays with scale, but discovering that it can be moved by turning a small crank driving a gear box is a surprise that leads to inquiry. How do gears multiply the outcome of this small effort?

Figure 39 - Bronze Ship's Propeller. Photo: T. Kasanda. Toronto. ON.

Figure 40 - Turn the crank to move. Photo: T. Kasanda. Toronto. ON.

Intuitive Exploration

The best exhibits are those that need no instructions to initiate. The design of the experience makes the interaction so obvious and intuitive allowing the visitor to immediately start to explore and connect. In Rotating Faces, the three-dimensional blockheads stand out in contrast to the flat bodies supporting them inviting a hand to explore and with each turn of a section, a new expression is revealed.

Figure 41 - Rotating Faces. Every turn creates a different expression. Photo: Ontario Science Centre. Toronto, ON

Visitor becomes the exhibit or part of the exhibit

...both to learn about yourself and share with your friends.

Figure 42 - Flexibility Test
Photo: Ontario Science Centre. Toronto, ON.

Physical engagement

... to personally experience a physical phenomenon like centrifugal force pulling on your body.

Figure 43 - Rotation
Photo: Ontario Science Centre. Toronto, ON.

Competition

...can be used as a natural motivator to engage visitors. How high can you jump? and what muscles are required or used?

Figure 44 - How high can you jump?
Photo: Ontario Science Centre. Toronto, ON.

Cooperation

...can also tap into sense of family and joy in working together to solve a problem.

Figure 45 - Pattern Talk. Can you communicate your pattern to your partner? Photo: Ontario Science Centre. Toronto, ON.

Juxtaposition

...draws on our natural tendency to compare and evaluate things that are new vs old, familiar vs unfamiliar, simple vs complex, seen vs unseen. We ask: Why are they different? Which one is better? And what are the qualities that make it better?

Figure 46 - Iceman vs The Material Girl. 5300 years later the materials are different, but the needs are much the same. Photo: T. Kasanda. Toronto. ON.

Simple opportunities to play

...can be opportunities to learn when the play has interesting outcomes directly connected to the interaction.

Figure 47 - Music Play. Photo: Ontario Science Centre. Toronto, ON.

Iconic Phenomenon

….inspiring wonder… such as experiencing G forces on a bike you pedal 360° in a loop.

Figure 48 - How many G's can you experience on the G Force bike?
Photo: T. Kasanda. Toronto. ON.

Open ended experiences

...like the Build Your Own Coasters kit of parts. I watched this family play for an hour, switching parts around, testing, observing the outcomes and trying again. "How can we get it (the ball) over that hill?" "It needs more energy" ...all the while smiling, jumping around and perhaps only aware that they are having fun.

Figure 49 - Build Your Own Coaster prototype.
Photo: T. Kasanda. Toronto. ON.

Interconnecting and putting science in reframed or relevant context

...reminding visitors that science is everywhere in their daily lives and an understanding of the underlying science can improve your outcomes...for example in sport performance.

Figure 50 - Discover science in the Sport Show. Photo: T. Kasanda. Toronto. ON.

Demonstrations

Provide great connections to unique content and enable personal connections between visitors and staff.

On this 16-foot diameter rotating platform visitors have an immersive opportunity to experience rotational forces and a chance to perform and shine in front of their family and friends.

Figure 51 - Revolver Demonstration Theatre.   Photo: T. Kasanda. Toronto. ON.

Maker Activities

A form of open-ended activity and recent trend in informal science is building innovation skills through maker activities. The OSC's Make Something New exhibit encourages visitors to create a shoe (or something else) out of a supply of cardboard, tape, fabric offcuts and other found materials. Similarly, the Challenge Zone invites groups to prototype and solve a given challenge like making a device to launch and catch an egg.

More than just Exhibits!

Although physical exhibit offerings are top of mind when thinking about a visit to a science centre, these institutions offer so much more.

- Programs for schools, typically one hour engaging demonstrations in a classroom or theatre setting presented with specialized equipment by professional demonstrators.

- On floor Hosting Staff personalize a visitor's experience with person to person interaction, hosting small demo carts, answering questions or entertaining with puzzles and science tricks sometimes called "Pocket Tricks."

- Hosting special events like science fair finals, robotics competitions, ministerial announcements, and conferences.

- Summer camps, birthday parties, sleep-over programs.

- The OSC even runs an accredited Science School for approximately 30 selected Grade 12 students to obtain their science credits during a term delivered on site.

- Science centres are the local authority for science information on current science events, often providing expert commentary to news organizations.

- Outreach programs to schools and community events.

- On-line science communication development through website and social media.

With such a range of experience types to draw on, science centres should still be able to maintain relevance and command the attention and interest of the public, yet in many instances, attendance is dropping and sustainability is an issue.

APPENDIX C - TYPICAL EXHIBITION DEVELOPMENT PROCESS

Excerpt from "Exploring Challenges and Opportunities for Informal Science Centres Through an SFI Lens" (Kasanda T. 2015)

Every project will have unique requirements depending on the goals, nature of the content and stakeholders such as external clients. Generally, the Exhibits Development Process is comprised of the following activities:

- Project Definition
- Broad Scan Research
- Vision, Mission and Goals
- Concept Development Phase
- Broad Scan Research
- Brainstorming, Visualization
- Preliminary Concepts
- Design Development Phase

- Concept specifications
- Prototyping
- User-centred iterative testing with visitors for usability, understanding, feedback and impact
- Design Intent drawings
- Graphic and Visual Communications Standards
- Draft Copy, Final copy
- Graphic Design layouts
- Floor plan
- Manufacturing detailing and Engineering
- Exhibits Fabrication Phase
- Testing and Commissioning Phase

Like most design processes, exhibition development is initially divergent and eventually convergent. Although the process can be described in somewhat linear terms, its highly iterative nature involves much more overlap of phases.

Project Definition and Concept Development Phase. During this process, the core team will conduct in-depth research on the subject matter of _____. This process entails broad scan research, discussions with materials research innovators, educators and leaders, content/concept brainstorming, content/concept assessment and analysis, curriculum content research and assessment and preliminary design exploration.

As part of this process, the Exhibit Developer will conduct two charrettes.

Introductory Charrette is a 3-day meeting organized by the Exhibit Developer to initiate the Conceptual Development Phase.

This meeting is an opportunity for Exhibit Developer's staff to engage the client's staff and selected research innovators, educators and leaders in exploration, brainstorming and exchanges of ideas. The key deliverable from this activity will be the development of Vision & Communication Goals.

Vision & Communication Goals. This document is prepared by the Exhibit Developer to express in words the overriding vision and experiential philosophy that will drive the selection and presentation of Exhibits, programs and other elements for the visitor's total experience. This document also includes between 6 and 10 prioritized communication goals.

Preliminary Design Documents. The Exhibit Developer will use the information and ideas generated during the Introductory Charrette to begin to prepare Preliminary Design Documents.

Interim Content Report. This document is prepared by the Exhibit Developer, and is the result of initial broad scan research and the Introductory Charrette. This document outlines a broad range of relevant and interesting content with Exhibit potential. The material is organized and evaluated into potential threads or sub-themes and will begin to show the potential content structure of the Exhibition through preliminary narratives.

Preliminary Ideation. This document is prepared by the Exhibit Developer, and is the result of initial design concept exploration research and the Introductory Charrette. This document consists of sketches of potential interactive elements and details as well as vignettes that explore the environment and context that will anchor

the content. This document may also contain bubble and relationship diagrams; draft design criteria and preliminary narrative relating to potential approaches to the look, feel and voice of the Exhibition.

Interim Curriculum Report. This document is prepared by the Exhibit Developer, and is the result of initial curriculum investigation and the Introductory Charrette. It outlines the potential sources for curriculum feedback that the Exhibit Developer will explore. This document also outlines potential questions regarding existing curriculum and teacher needs to which answers will be sought.

Development Charrette. This three-day meeting is organized by the Exhibit Developer to review and discuss preliminary ideas and findings, and to set the direction for the completion of the Conceptual Development Phase.

This meeting is an opportunity for the Exhibit Developer's staff to receive feedback and direction from client and selected research innovators, educators and leaders and to continue more in-depth exploration, brainstorming and exchanges of ideas. The key deliverable from this activity will be a Development Charrette Report. Implementation of the directions set at this charrette will lead to the completion of the Exhibits Development and Design Brief.

Exhibits Development and Design Brief. This multi-part document is prepared by the Exhibit Developer, which defines the scope of the Exhibition to be designed and produced. This document includes the following:

- Definition of the Exhibition through narratives outlining the Exhibition intent, content organization, the look, feel and voice of the Exhibition. This will include a broad-stroke description of the overall visitor experience (i.e. - what the visitor will encounter in the Exhibition) and a description of potential iconic centre-pieces.

- Definition of criteria that define the visitor experience for the Exhibition and individual thematic areas.

- Definition of criteria for specific Exhibit development and selection.

- Production of several conceptual design sketches of the Exhibits. These artist's impressions will be colour drawings intended to convey the character of the Exhibits space including iconic experiences, possible environmental elements, possible links between art and science, and potential colour and material palettes. These drawings are not intended to define or display final floor plans or comprehensive Exhibit selections.

- List of design parameters with regard to the fabrication and touring considerations

- A revised budget review and schedule of work for the design development and fabrication phase of the project.

- Some completed Exhibit Concept Specifications.

- Preliminary Exhibit Concept List which describes a range of Exhibit concept possibilities 150% greater than the final scope of the project. Each concept includes a two or three sentence outline, indication of relative scale and value of the experience.

- Science Education and Programming Plan describes the scope of work to be undertaken in providing formal education materials and developing educational programs in response to school curriculum needs.

The client provides feedback through a critique and confirms approach to be developed in the next phase of the work through sign-off.

Following agreement and signoff on Exhibits Development and Design Brief including the selection of 120% of the Exhibits from the Preliminary Exhibit Concept List, the Exhibit Developer will undertake the Design Development Phase

Design Development Phase. This phase is a process where the Exhibit Developer's core team and support specialists will prototype, test, evaluate and formalize the design of the Exhibition. Each of the following elements represents a milestone and signoff that triggers

progress payments. Where documents are prepared for individual Exhibits, sign-off triggers progress payment by the Client.

Design and Production Plan. This document, prepared by the Exhibit Developer, describes the timing and work-flow for Design Development and Production. This document is created once the final Exhibit list is approved.

Exhibit Concept Intent Specification. Each Exhibit will be detailed in the following terms:

Exhibit description, Exhibit experience, level of interactivity, fit to mission, learning styles, age appeal/appropriateness, equipment required, curriculum connections, visitor dwell time, number of visitors accommodated at one time, staff resources required, approximate cost of consumables, approximate footprint of the Exhibit, Exhibit sketch and cost to complete.

Prototype Assessment Reports will establish prototyping goals and parameters for each Exhibit that is deemed to require prototyping during the development of the Exhibit idea. This process includes the definition of what kind of prototyping (concept, design, manufacturing, or interface prototyping) is required for the Exhibit and how that is

likely to be achieved. Client will review and approve the direction of the Exhibit development. Types of prototyping include:

1.   Concept prototyping – testing an idea to discover if it results in a desired and valuable experience.

2.   Design & Manufacturing prototyping – testing details, components, mechanism and materials for suitability with respect to visitor use, accessibility, durability, safety and practicality as an Exhibit element.

3.   Interface prototyping – testing the suitability of the Exhibit communication interface, whether text based, graphical, physical or otherwise implied.

Prototype Testing Reports. The Exhibit Developer will determine the initial physical parameters and configuration required to obtain relevant prototyping information. A prototype is set up. In addition, a venue for prototyping is chosen based on the configuration and the prototype is evaluated in the appropriate venue.

If required, an evaluation questionnaire will be developed which outlines a number of key issues or questions about the Exhibit for observation, including (if necessary as part of the prototyping exercise goals) evaluating the stated goals of the Exhibit. The Exhibit Developer will evaluate the Exhibit and record observations on the questionnaires. When appropriate, interviews will be conducted with visitors regarding their experience. The Exhibit Developer will review the data collected and provide a status report to the Client's Representative regarding the Exhibit.

The status report will include summaries of assessment, goals, observations and evaluations; and may include suggested changes to the original Exhibit description; the Exhibit Developer's recommendations for next steps; comments regarding consumables, staffing and other operations issues; and questions/decision points to which the Client needs to respond.

If the prototyping goals are met for the Exhibit and are approved by the Client's Representative, the Exhibit will proceed to the Design Drawings stage.

Photographs and/or videos may be taken as relevant at each stage of the prototyping process to provide a record of changes made to physical layout, graphic text, and graphic placement. The Client's Representative will be provided with photographs as part of status reports if required in the opinion of the Exhibit Developer.

Preliminary Typical Floor Plan: A two-dimensional rendering showing a layout of proposed Exhibits within a typical 5000. The rendering will consist of a preliminary plan of each Exhibit indicating its probable scale, typical or required spacing. At this phase, several options will be shown to discuss and compare the critical mass of the Exhibits and balance of content and interactivity, depending on which Exhibits proceed into final design

Exhibit Design Intent Drawings: Drawings of Exhibits that detail the information needed to either fabricate the Exhibit in our production facility or provide a base from which shop drawings may be created prior to fabrication. Details include the dimensions of the major components, specification of materials, and specification of finishes. Each design drawing represents a major sign off milestone.

Graphic and Visual Communications Standards: A series of documents and sample graphics that set specifications for how visual and graphic materials will be implemented. Standards include specifications on fonts and sizes, font usage, colour pallets, design presentation, copy levels (headings, informational, instructional) and production techniques. Once signed off, these standards are used for the implementation of graphics throughout the Exhibits.

Draft Copy: An interim step in the Exhibits Development Process where text is developed to work in conjunction with the evolving Exhibit Concepts to convey and enhance the content message as well as provide activity instructions. Draft Copy is submitted for Client's Representative review with regard to scientific accuracy.

Graphic Design Layouts: Proof prints, generated by the Exhibit Developer, of final design layouts that provide enough information for the production and installation of final graphics onto the Exhibits. Graphic design includes the identification and procurement of the rights to use photographs or illustrations, the positioning of approved text and images and the selection of fonts and background colours in accordance with the approved Graphic and Visual Communications Standards. Graphic Design Layouts are submitted to the Client's Representative for sign-off with respect to scientific accuracy and consistency with the approved Draft Copy and Graphic and Visual Communications Standards. The sign-off procedure is detailed in the language of the contract.

Final Typical Floor Plan: A two-dimensional rendering showing the layout of the final selection of Exhibits within a typical 5000 sq. ft. area. The rendering will indicate: the final plan of each Exhibit, locations of major elements and interactives, typical or required

spacing, probable visitor usage (number of visitors accommodated) and typical queuing patterns.

Exhibits Fabrication Phase: During this phase, the Exhibit Developer undertakes the preparation, construction and first installation of the Exhibits. Fabrication will be consistent with the approved Exhibit Concept Specifications, Exhibit Design Intent Drawings and Graphic Design Layouts.

On-site Testing and Operation Phase: During this phase, the Exhibits will be installed in an Exhibition Hall and opened to the public. During this period, the Exhibits will be promoted and staffed by the Exhibit Developer. On-site evaluations will be conducted with respect to the effectiveness of the message communication and the durability and maintainability of the design. Remediation will be undertaken within the scope of the remediation budget in the Program

Packing, Shipping: The Exhibit Developer will plan, fabricate and supply appropriate crating and material handling equipment required to professionally transport the Exhibits, in accordance with the contractor's common practice. The Exhibit Developer will arrange the packing of the Exhibits after the On-site Testing and Operation Phase and arrange the shipping of the Exhibits to the first venue.

APPENDIX D- RESEARCH QUESTIONNAIRE

Expert Interview - Protocol (questionnaire and guide)

Remember to use the first few minutes to build a rapport with the candidate. Also remember to have the consent form signed prior to beginning the interview.

Hi, Thank you for taking the time to speak with me.
As I noted previously, my name is Tom Kasanda. I'm working on a Major Research Project for my Masters Program in Strategic Foresight and Innovation at OCAD University. Through this research, I hope to gain insight into collaboration methods and platforms that might enhance the exhibition development process.

I have provided you with an informed consent form. Do you have any questions?

I just want to remind you that participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time, or to request withdrawal of your data within two weeks of the final interview.

I'll be taking notes of our conversation. With your permission, I would also like to record the conversation for the sole purpose of reviewing any key points I might miss. Would that be ok?

Interviewee name:
Age:
Years in the field:
Organization:
Contact info:

1) Can you tell me about your experience and current work in the field of remote collaboration?

2) What methods of, or platforms for remote collaboration have you used?

3) What are the primary advantages of using a remote collaboration platform?

4) What are the key drawbacks of current remote collaboration platforms or methodologies?

5) Have you any thoughts on how to mitigate those drawbacks?

Is there anything else you might like to add, or any question you might have for me.

Thank you for your participation.

T. Kasanda   Student No: 2552149   Page 1 of 1
SFI MRP REB application Ver. 2016-11-29 11:56 pm
Improving the Future of Informal Science Learning through enhanced collaboration methods and platforms.

APPENDIX E - DETAILED FINDINGS FROM REMOTE COLLABORATION EXPERT INTERVIEWS

In Chapter 2, I identified that an understanding of remote collaboration was a critical factor in the development of successful co-creation platforms. My next phase of research was to build this understanding.

PROCESS

Through literature review, academic contacts and an open call on a list serve, I identified seven expert users involved in remote collaboration. This diverse group consisted of three women and four men ranging in age from their 30's to 50's with 10 to 20 years of experience in the field. Four experts were from multinational companies, one from a remote collaboration platform, one was an international NGO consultant and one was the principal in a small private UX consultancy.

Experts, through an interview process, were engaged in discussion that explored the following areas:

- Anecdotal experiences with remote collaboration and how it has evolved over the last decade.

- The key factors, competencies and values required for successful collaboration.

- Methods of and best practices for remote collaboration.

- Identification of platforms used and their strengths and weaknesses.

- What are the primary advantages of using a remote collaboration platform?

- What are the key drawbacks of current remote collaboration platforms and methodologies? How are those drawbacks mitigated?

Appendix D "Research Questionnaire" provides the interview protocol for the expert interviews. Notes were taken and interview recordings were transcribed. These were examined for key statements and opinions.

FINDINGS

On the whole, these experts concurred that engaging in remote work is a given now for increasingly distributed multinational organizations.

Methodologies are evolving and current methodologies have distinct advantages and disadvantages. The trajectory is that remote work and remote collaboration will continue to increase both in prevalence, productivity and success.

"When dealing with large companies, there is no such thing as a project that at some point doesn't have a remote member. This is the nature of the business these days and I don't see that going away. Companies are getting more and more distributed. That is a current trend." Expert #2

📄 Key drawbacks of Remote Collaboration

Despite the fact that the majority of experts advocated the necessity and advantages of remote collaboration in their fields of work, they were clear that drawbacks remain. These drawbacks were important to be cognizant of and required attention in order to mitigate pitfalls that reduced the larger benefits of remote collaboration. Primary drawbacks include:

- Loss of the in-person social and physical connection
- Reduction of interpersonal communication and interaction cues
- Inability to interact with physical artifacts
- Lack of buffer between work and home life

Experts consistently concurred on the one main drawback to remote collaboration – the **loss of the in-personal connection** that supports

spontaneity in communication and immediate access to verbal and non-verbal interaction cues between participants. Although chat and video conferencing can provide surrogate levels of information, restrictions on bandwidth and field of view begin to degrade the immediacy and flow of collaborative discussion. The degradation increases quickly as the collaborative group size rises.

"…when we're in a room we can see people's faces, we can see body language. That is so important… understanding the mood or how someone responds to something you say that can really change how you proceed. You can change track. You can change your approach. You don't get the benefit of that in MURAL.[43] You're focused on the work on the canvas in front of you… …I have found that we're focusing more on remote collaboration and I've actually had more issues with personalities…in terms of maybe overstepping or not seeing someone's dynamic and talking over people by accident or jumping in and cutting other people off because I want my chance to speak and I can't sense the room. It creates different kinds of interpersonal challenges". Expert 1

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[43] www.MURAL.ly is an on-line collaborative tool designed to function similar to a whiteboard. MURAL enables multiple remote users to draw, post notes and organize information in an online collaborative space.

Humans, as evolutionarily tribal and social beings, inherently develop group cultures through their interactions. Successful team cultural development can be hampered by the above drawback and requires special attention to overcome.

Expert 3 speaks about the challenges of moving beyond an interaction where:

"…I show you something and you comment on it…." Expert 3

The typical example of this would be emailing a document to a group of people for feedback.

"The challenge was how do you go from a one person sharing to one other, or one person to many, to a shared canvas and possibly many to many…"
"We used to talk about collaboration at a time when we were really just talking about conferring…which is so different than actually making something together…and maybe that is co-creating…" Expert 3

I found Expert 3's expression of the difference between modes of sharing important to reflect on. Figure 52 visualizes the spectrum from conferring to co-creating in terms of these modes of sharing.
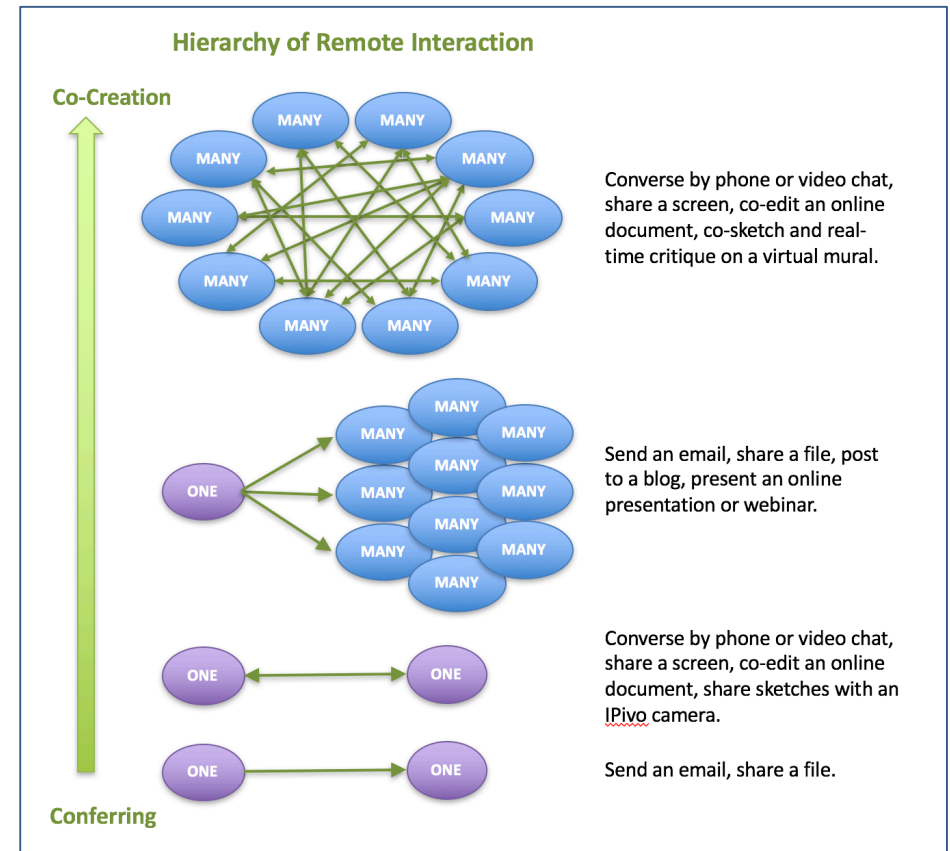
Figure 52 - Hierarchy of Remote Interaction – This visualizes Expert 3's notion of different modes of interaction from 'One to one' to 'one to many' and then to 'many to many.'

Expert 1 described the challenge of live-sketching remotely.

"…it tends to be a one-way street…an IPevo document camera allows you to share your sketches with someone live remotely, and they can share their sketches live if they have a camera, but you can't work on the same sketch as if you were in a room together…the spontaneity is different."

It will be important to explore the conditions that support the shift from 'one to many' to 'many to many' in sharing information and creating together.

Although six experts spoke favorably about remote collaboration and its necessity in the current realities of distributed organizations, Expert 5 rejected the viability of remote collaboration in their context.

"We are moving away from remote collaboration, not working, we tried so many ways, we weren't getting the output or the speed to be competitive in tech space when things are moving so quickly, not being together was really becoming a barrier. Projects are organized by location if you are not there; you are not on that project. Remote collaboration is mostly to inform and share information and status." Expert 5

Another clear challenge with remote collaboration is the **inability to interact with physical artifacts.** Although sticky notes on white boards can now be emulated in some platforms like MURAL, and digital models and "walk-throughs" or representations of 3D space can be

shared, physical three-dimensional models like product prototypes can only be shared two dimensionally via video. Technically, models could be reproduced locally with 3D printing but shared interaction remains limited.

"We rely on artifacts that the team is already creating and using…and when the teams are working together, you have engineers and designers across different skills. If you are co-located, there are tons of stickies on the wall, different flow maps…Living artefacts that can be left-on the wall so that you can walk by, look at it again…what is important is the ability to step back and see everything spatially…versus when you are on a screen, you are restricted to seeing one thing, and then you move to the next thing, your brain doesn't process those things quickly, you can't see patterns or see things pop up as opposed to being immersed in the artefacts." Expert 5

According to Expert 7:

"I've been doing this for so long that I don't necessarily see anything as a drawback…I don't see remote as a constraint" Expert 7

This would imply that if you work at it long enough, embrace it and it becomes your culture then the remote aspect is not a significant issue, which leaves mostly benefits to be gained.

"The one drawback from working from home is the lack of buffer between work me and home me." Expert 7

This points out that we have different modes of interactions for different relationships, and it is important to be conscious to switch from 'work intensity' or 'client communication' to 'family mode' and vice versa as the situation dictates.

📑 Advantages of Remote Collaboration

Despite the drawbacks noted earlier, my expert proponents of remote collaboration pointed to numerous advantages that outweigh the adjustments required for working remotely. These advantages include:

- Access to experts anywhere in the world
- Access to more expertise on an 'as needed basis'
- Reduced or eliminated commute time
- Improved lifestyle
- More culturally diverse teams
- Enhanced concurrent multitasking
- Real-time sharing of information

A big advantage was the ability to **pull together experts onto a team from anywhere in the world** instead of limiting the team to those available locally. Whether a team is global, or just working from home, **commute time is reduced or eliminated**. This then reduces travel costs and environmental impact. Many, as a result of remote work, find **improved lifestyle** and family time benefits.

Companies that are partially or fully distributed have less overhead in terms of office space.

When employees are sick, perhaps with a cold or flu, that does not get spread around the office. As well, when you are already set up to work from anywhere, you can continue to be productive even when it isn't advised to come into the office.

With the current reach of the internet, it is possible to **bring together more culturally diverse teams**. In developing products or services for a global market, this has distinct advantages. However, Expert 4 advised that it was also important to be mindful of cultural barriers.

> *"Some countries, corporations, cultures are more open to free expression. Other cultures are more formal, hierarchical in communication where 'saving face' is important, especially saving face for your superiors." Expert 4*

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In looking at the advantages and disadvantages of remote collaboration, there seemed to be a common theme. The success of remote collaboration depended on making adjustments to you and your teams behaviors to account for the differences to in-person collaboration and the social conventions that make in-person collaboration successful.

📄 Key factors in successful remote collaboration

As I listened to the opinions and recommendations of these experts, I realized that remote collaboration is not for everyone.

In fact, in some circumstances it can be quite difficult and unsuccessful. In parsing the conversations, it was possible to identify factors that led to more successful remote collaboration.

- Investment in technological infrastructure
- Culture of equality and "agency"
- Transparency - working in the open
- Open Critique
- Role definition
- Onboarding process
- Diversity of discipline, thinking and cultural perspective
- Good housekeeping (process and document management) and planning
- Assign independent work where feasible and task appropriate
- Build teams who have worked together, have common work styles and like working together
- Clear management and decision making
- Use technology to support communication, coordination and sharing of data
- Use a strong enough infrastructure (bandwidth)
- Build the right culture - trust, social comfort, cultural sensitivity, egalitarian participation

These success factors include:

- Shared sense of vision, purpose and goals
- In person kick-off meetings
- Build on line personas
- Understanding of online personalities
- Virtual check-ins

The most important factor expressed was to have a **shared sense of vision, purpose and goals for the initiative.** This can be articulated at the onset and reinforced through the use of road maps, framing documents and agendas. In conjunction with this, building a common understanding of roles and responsibilities.

Where possible, have an **in-person kick-off meeting** to boost start-up momentum.

> *"Virtual collaboration is most effective if combined with face-to-face and preferably when you start face to face." Expert 4*

This helps **build the social and interpersonal component** of the team. If an in person kick off isn't possible, you can build in an **on-line social component**. This can be done through an on-line "ice-breaker" …something fun so that the team starts up building the social component before getting into the project complexities. Team members might be encouraged to develop and post **on line personas** to introduce themselves. Build social components into the process with time set aside for **virtual 'water-cooler' check-ins**.

When inviting people to collaborate on line, especially in contexts where this collaboration may be voluntary, Expert 4 stresses the need to **demonstrate the value** of the remote collaboration to their immediate needs. As there is a learning curve investment each person needs to take, selling the value and potential outcome is needed to sustain the initial investment until a critical sustainable mass of participation is achieved.

Expert 2 spoke of the importance of **understanding that people tend to have an on-line personality** and an in-person personality and their on-line engagement may be different than in person.

Another take-away of in-person and on-line personality is that some people will be more outgoing and expressive in person, others will find it easier to post their thoughts and ideas digitally. Understanding this allows leaders to recognize and develop team members' on-line competencies and build teams to succeed on-line.

An organization itself must **invest in its technological infrastructure.** Providing staff with the requisite screen space, applications, computing power and high-speed band width is critical in providing field of view and reducing latency and simulating in-person interactions.

> *"You need a suite of tools... you are going to need different tools for different things...and the team should determine at different points in time what tools are going to be useful for them. The configuration of the team changes over time and the team's needs change over time so the tools change over time as well." Expert 3*

Remote collaboration requires **planning**, especially in the start-up phase. This involves both process planning and technology planning. The project lead needs to ensure participants understand the process in advance (agenda, activities, intentions, preparation required) so that actual on-line work is focused on the creative and generative aspects. Preparations might also involve test-running the technology to ensure the level of result desired. You have to know what works and what doesn't before you launch, otherwise you run the risk of wasting a lot of people's time. Each remote site or participant needs a checklist of tools. There are benefits to providing templates for how to set up the equipment in your office space. Templates for the screen work space

(a protocol for the layout of elements on your screen) can optimize the location of software / platform components on screen so that time is not wasted organizing during collaboration sessions.

> *"Optimize your screen setups to see people as well as when you are sharing [your screen] or being shared with...so you can keep the social component alive as you are sharing the work..." Expert 3*

Always try to maximize personal connections through video.

Expert 1 felt that for some types of work, it was important to limit the team size and important to be aware of diminishing returns as a team size grows.

In Expert 4's experience in setting up virtual platforms for NGOs and governmental agencies in order to share expertise, it was critical to set up **a culture of equality and "agency"** where the site or communication was not dominated by one person.

> *"If virtual platforms become dominated by one person then they die and I've seen it many times. It's almost impossible to recover from that situation because it sets up certain dynamics. People figure out that this is one-way communication and they go there to get the information but not necessarily engage." Expert 4*

Role definition is so important. You also need to identify the core contributors versus the peripheral experts.

Remote collaboration is an acquired skill; you get better with practice. There are methodologies for how to be a good remote collaborator so it is important to help your team acquire these skills. This is a list of practices that support the development of remote collaboration skills.

- Have a really strong onboarding methodology.
- Share a checklist of abilities.
- Provide guidance on how to approach the experience.
- Identify common pitfalls, typical experiences.
- Provide tips to make it work, get the most out of it.
- Provide standard set ups for desktops to save time.
- Identify a tools list explaining purpose, pros and cons.
- Provide simple rules of the road for everyone to be aware of.

In maintaining a distributed work team, Expert 7 noted two important behaviours they incorporated into their ongoing practice:

- Daily stand up video chats. This reinforced a verbal commitment to the work that you would do that week. It was like a social contract and helped maintain a personal bond between employees.

- When the staff were located within a commutable geographic area, they planned once a month in-person group time to review project work. As the staff became more distributed, they shifted to bi-weekly on-line sharing.

Requisite competencies, characteristics and preferred behaviours for remote teams

Some of the experts noted that there were competencies and characteristics they looked for in prospective employees or that were important to acquire to be a successful remote collaborator.

These included:

- Shared Values
- Mutual understanding
- Flexibility
- Attention to communications
- Technical literacy
- Conceptual understanding of zooming in and out
- Mastery of the "Digitally Defined Workplace."
- Channel fluidity
- Multi-device literacy
- Flexibility in adopting new tools
- Assertiveness
- Self-awareness
- Empathy

Expert 3 emphasized the importance of building not just a shared vision, but **Shared Values** for behaviour. This includes having an understanding of what pieces and roles there are on a team, the benefit to fill all the roles and the value to play a role even though you might have other roles you could play. This leads to both individual and team self-awareness which is critical to managing the complexity of human dynamics…. knowing when to push back and when to let go in the context of the greater benefit to the "team's success."

> "In the collaboration context there are so many interesting dynamics, one is that you are in there and you want it to be successful and you may actually sabotage it by your own desire for your own contribution to be heard and really successful and so I think successful collaborations really need to go beyond what's the contribution to what is it that we could possibly emerge with as a group….which means that you are going to have to be ok with some of the decision making styles in the group…and how you get to certain things …and in the end…eventually you get so far away from the events…the collaboration itself…that all you see is the thing that you collaborated on…and this pride that comes up out of that…all of the human niggly stuff that you might have experienced in that collaboration…now gets this shiny light of 'oh this is the best project' there is a sense of real pride…"Expert 3

In this process, we need to build **mutual understanding** of the value of being exposed to the "deep thinking" of others and finding inspiration to build and evolve.

Flexibility was considered an important character trait for remote collaborators, especially on globally distributed teams with differences in time zones. Flexibility included being willing to meet online at odd hours as a trade-off for the ability to set your own work schedule.

Constant **attention to communications** such as instant messaging builds virtual presence. In an office, you can go find someone for a critical piece of information. Answering emails right away (as opposed to answering emails at the end of the day) mimics that presence and keeps the process moving.

Technical literacy includes building individual skills with the equipment and platforms. You have to know your computer settings and mic settings for video conferencing. You need to know how to share your screen. You need to know your way around the project's file management systems. These are critical to productivity and work-flow when one non-literate member can bring an on-line meeting to a halt.

An interesting thread on technical literacy put forward by Expert 2 is that many collaborators are unfamiliar with the concept of **Zooming**.

"A hypothesis I have, when we are talking specifically about MURAL[44], is that people aren't accustomed to or even willing to interact with their information on a zooming level." They are used to scrolling through it. The process of programming tends to be linear. If this, then that. The code is linear." Expert 2

An ability is required to understand the medium of a cloud-based white board that requires zooming in and zooming out. This non-linear thinking is a learned design thinking skill that is not intuitive for many people. People who use AutoCad, Photoshop or Illustrator may have more of a foundation in this area.

"The key teaching point is how to use zooming, both physically and intellectually to enhance non-linear thinking. And if we go back to technical literacy, we have to ask if your technology, the little red joy-stick in the middle of your keyboard, allows you to zoom successfully." Expert 2

Mastery of the "Digitally Defined Workplace." Expert 2 introduced me to this idea. In a real office, everything has its place: desk, file cabinet, meeting room, calendar / planning board, notice board, water cooler, copier, whiteboard, etc.… and everyone knows where they are

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[44] www.MURAL.ly is an on-line collaborative tool designed to function similar to a whiteboard. MURAL enables multiple remote users to draw, post notes and organize information in an online collaborative space.

and when and why to use them. The same is true for the virtual office and virtual collaborators need to have the same level of comfort with the tools and their uses.

Expert 2's version of the "Digitally Defined Workplace" includes:

- Real-time communication (phone and video conference)
- Chat (which can be real-time, but is more of a recorded sequential digital conversation)
- Formal communication like the memo and email
- Storage, repositories of shared common knowledge
- Planning and management - scheduling and coordination of meetings, tasks, resources (Outlook)
- Visual collaboration including the digital whiteboard, digital flipchart, and digital sticky note.

"the last piece to be able to collaborate effectively in the Digitally Defined Workplace is that visual collaboration, the whiteboard, the flipchart, the sticky note...I'm looking for someone who can manage all of that stuff [as an effective employee]" Expert 2

Expert 2 refers to **Channel fluidity** as the ability to bounce between different platforms using the right platform for best purpose.

"The three of us were able to fluidly go between these things without having to say 'wait, where is the link, wait how do I tag you in...' I mean it is a very physical technical skill that we

had...but once you had that...that collaboration can be just as rich if not richer than face to face." Expert 2

Multi-device literacy is the ability to work simultaneously on multiple devices to suit the needs of the task at hand e.g. computer with multiple platforms open, a smartphone for another layer of chat (increasing one's bandwidth), using an external camera to capture sketches or images of models, using a tablet to add sketches to a virtual white board.

We see now in conference lectures and debates this added layer of communication where concurrently with a speaker's presentation, a projected twitter feed can allow a broader group to engage in a concurrent conversation and instead of one way communication of ideas, collective mind and collective thinking evolve.

For Expert 7, a primary employee competency to collaborate remotely is **Assertiveness**. You can't be afraid to put your work out there. You can't be afraid to ask for what you need.

"It is ok to bug me, to ping me for help. That is really the habit we had to cultivate in our employees." Expert 7

Communicating status regularly is crucial to remote collaboration.

"Dealing with information is the responsibility of the receiver not the sender" (Expert 7 quoting his business partner)…The sender should be generous with how much information they convey…where they are in a project…in a task…or what is holding them back…over communicate. The receiver is responsible for…getting that information, parsing it and dealing with it." Expert 7

This has to be an understood competency and accepted critical culture because the Project Manager can't walk around and tell each team member in person.

Self-awareness is a critical value for collaboration and especially so for remote collaboration when many of the in-person communication cues are not visible.

"…cultivating that ability to be very deliberate about your communications requires a certain amount of self-awareness…. of how your behaviours affect the team and affect the work" Expert 7

In the same respect, **Empathy** and the ability to look at something from someone else's perspective is valuable for collaboration.

When I probed as to what competencies to look for in employees in respect to being successful when you are working over distance, Expert 7 had an interesting response.

"What I like about this question is that it exposes the red herring that I believe is remote [work]…in the early days of Eight Shapes[45], we would get a lot of negative feedback from employees who would say…this would work a lot better if we were in person…and when we dug into that…it was clear that what they were talking about was collaboration behaviours, not remote collaboration behaviours. Remote adds a dimension and a dynamic to collaborative relationships, but at the end of the day, if you are a good collaborator, whether you are remote or not shouldn't matter." Expert 7

So, if this is true…it may be equally or more important to identify and evaluate collaboration competencies than to focus on the platform. Creating the composition of a team and building their collaboration skills could be the primary driver of success. Perhaps those giving up on remote work are bringing people together because it is easier to build those skills in a room together.

Alternatively, if the requisite skills and culture are built inherently and systemically into the platform and naturally facilitate the desired behaviours, this could be a substantial driver of success.

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[45] Eight Shapes is the name of the company Expert 7 cofounded as a UX design firm with a completely remote workforce.

Shared Values have been noted as an important behaviour for remote teams. Experts noted a specific set of values they promoted.

- Trust, Passion, Commitment, Willingness.
- Respect for the value diversity of opinions.
- Respect for the value of listening. This is both having the patience to listen as well as valuing the action of listening by others.
- Respect for Dissent - Embrace dissent and look for underlying issues.
- Appreciation for collective wisdom.
- Transparency.
- Sensitivity to inclusivity.

Trust was the most often considered value for remote collaboration. Incorporating this value into a team culture and having every individual embrace this seemed to be a key ingredient in overcoming the pitfalls of remote interpersonal interactions. Trusting that someone was doing their share of the work, trusting that your ideas

were being considered, trusting that your posts or comments will be understood in the spirit intended and trusting that if someone interrupted you in a discussion, it might just be the result of latency in video conferencing.

> *"You have to earn trust as a remote team member, but the team and the manager have to give you that trust. In remote work, it is necessary to give the trust first rather than to withhold and wait for it to be earned."   Expert 2*

Passion for the work or initiative might be considered important for any work, but the experts consistently suggested it was specifically important for remote collaboration. Passion, or perhaps **commitment**, like trust is an ingredient in bypassing remote obstacles.

According to Expert 3:

> *"**Willingness** is probably at the heart of it…" Expert 3*

When bringing together a new group or attempting to build remote collaboration capabilities, perhaps you have to ask people to take a leap-of-faith to be open to sharing and collaborating. Expert 3 spoke of the difference between Conferring and Collaboration.

> *"We used to talk about collaboration at a time when we were really just talking about conferring…which is so different than actually making something together…and maybe that is co-creating…" Expert 3*

Conferring is getting people's buy in, or getting advice. Conferring is a level of collaboration…but there is so much more.

> *"Yes, sitting in a conference room and chatting about something…getting someone's opinion about something is really not a fully engaged collaborative act. When we collaborate on something we both have 'skin in the game'…There is an equal contribution aspect, even if it is not equal. We are equal because we are making it together."*
> *Expert 3*

Winning teams, for example Olympic basketball teams, win together, everyone gets the same medal, some might contribute more than others…the stars…some might not even play…but everyone is necessary to have a team. Some of the guys who don't play have to be there for the starters to practice against. Everyone has a role, and those roles shift sometimes to fill gaps.

Respect for Dissent. Especially in leadership, the ability to embrace dissent and look for underlying issues is important to avoid "group think" and the blind spots that follow. Allowing team members a safe place where they can share both positive and critical ideas or opinions is an important part of building a culture of critique. This respect has to be built at a team culture level. In remote teams, with some of the interpersonal cues removed from the interaction and communication (blogging, instant messaging and posting comments in shared documents), having respect for dissent reinforces respectful debate, allowing the argument to be impersonal and result driven.

It is important to build an **appreciation for collective wisdom** and the process for capitalizing on the strengths of the group. In a process where you bring smart diverse thinkers together…you are looking for a thought dump…each new thought can inspire another or confirm or test current wisdom...the thinking work is in the listening and being able to identify the nuggets…and be inspired to create new thinking collectively.

Transparency was a value that Expert 1 spoke of. When everyone is not together in the same location, transparency of direction mitigates problematic tangents and keeps the team present to recognize valuable ones. Transparency of ideas promotes inclusion. Transparency of participation and work distribution keeps the team in balance and management aware. Transparency is an advantage, tracking work in an open manner for everyone to be able to see what everyone is working on. This enhances inspiration, real time feedback and contributes to keeping focus on the right things.

In cases where only part of a group is remote, Expert 6 spoke of the importance of **sensitivity to inclusivity**…so remote participants don't feel left out or excluded, [for example] from the jokes….so they feel like they are sitting at the table. Making sure there is a shared appreciation amongst the whole team when you have a couple remote participants.

These values need to be instilled into the project culture at the onset through leadership and 'work-shopping' collective adoption. A values charter could be a useful tool in supporting and maintaining collective alignment to best practice values.

Methods and processes that improve remote team success

During the interviews, experts shared their tips for methods and processes that help make remote teamwork more successful.

- Idea Bin to allow broader contribution of ideas
- Parking Lot to hold ideas that may not be relevant to the task at hand
- Silent Time for individual work during group sessions
- Retrospectives for concurrent evaluation of processes
- Version Control to capture iterations of generative work
- Cloud based in-document commenting
- Use a speaker phone or even better head set so your hands are free to work

An **Idea Bin** as an open call for ideas within a certain defined area. Expert 3 notes that:

> *"In circumstances where the team is too large and there are too many people who want to contribute, beyond the capabilities and roles in a project, an "Idea Bin" can be a repository where many people can contribute ideas as a collaborator….and then we would have a session to go through those ideas." Expert 3*

Setting up a wiki or a MURAL as an 'Idea bin' is one way to allow asynchronous idea-capture from a large group where having the whole group participate in person might be unwieldy and inefficient. You can leave the Idea Bin open and at points in time initiate a review to prioritize the ideas and decide what to take further.

> *"Another thing you can do when you have so many people and they all have ideas is to do an" Idea Jam" so you don't have a constant flow of ideas…because ideas are cheap…implementation is hard." Expert 3*

So, in this context an "Idea Jam" occurs as an invite to a discrete session.

A **Parking Lot,** which is subtly different from an Idea Bin, is used within a collaborative process to value good ideas that may be tangential to the focus of a particular session or exercise. Tangential ideas are parked for consideration later while staying focused on more immediate concerns and threads.

Expert 1 noted that in on-line idea sessions some participants are naturally quieter or more reserved in articulating ideas. Planning specific periods of **"Silent Time"** where everyone works individually in a shared workspace such as MURAL allows space for these individuals to put forward ideas without having to compete for air-time with more

extrovert personalities. Switching focus between group thinking and individual thinking may add diversity and richness to the work.

> *"…people can talk and talk and talk and words end up in the air and disappearing… silent ideation forces people to think and put down those thoughts." Expert 1*

Retrospectives are a group activity to check in on what is working and what is not in the current project and context. These are especially important in remote team work where challenges in team dynamics or individual satisfaction may not be in plain sight.

> *"We would set up a grid in MURAL and ask what would you change? What should we keep doing? What questions do you have? What ideas do you have?" Expert 1*

Version Control is an important feature and consideration for co-created documents. Using a platform of software that captures each iteration and evolution of a document is important for more than the data that is preserved. It is important to support the notion of trust and contribution within a team. People are typically fine with modifying, cutting pasting their own work. Editors also have comfort with changing work as it is specifically their role.

I have noticed in on-line MURAL collaboration that team members are fearful to mess with or move anything created by someone else. I can

only conjecture this comes from early developed values like "don't touch something if it isn't yours" and "put things back where they belong." Having the confidence to know that anything you change can be "rewound" provides a framework to allow team mates to creatively engage without potential backlash or negative consequences. Being able to mess with collective content is critical to developing alternatives and new thinking.

The use of **Playbacks** helps to manage the polarities of balancing or constraining team size with the importance of broader inclusion.

> *"…you recognize that a small team can be more productive and focused but the broader team can add a lot of value at certain points in time… when we have remote sessions, we really have to watch the numbers [of people participating] so we try to only invite the essential people and try to keep their numbers down, but then we also have regular playbacks and these can be formal or informal and that's where we invite the broader team. That's when we might invite more stakeholders. So, we can show them a presentation or prototype or whatever reflects the work that we've done in the past week. That gives more people an opportunity to provide feedback and input." Expert 1*

When introducing new methods, Expert 1 stressed the importance of an advance information session to teach the tools, explain the methodology and why the team will undertake it together as well as the expected outcomes.

Cloud based in-document commenting is a valuable feature for co-creating. Most on-line documents now come with the ability for multiple people to work on, edit and comment right within the platform.

> *"You can do things live together which I think is really, really key when doing remote collaboration, absolutely key. It just cuts down on getting different versions mixed up. Everybody can reference the same source. Any commenting or conversations that go on about a document, also helps to track the history of how that artifact has progressed." Expert 1*

There are now hundreds of online platforms that support remote collaboration. These platforms can provide many distinct advantages to teams and communities working at distance.

- Global access
- Direct to digital information capture
- Portable, archive-able, distributable, copy-able and sharable work product
- Traceability - inherently traces threads, tracks evolution
- Database storage of all captured data, artifacts, processes, discussion, work product
- Annotation, commenting and feedback processes
- Real-time sharing of information
- Concurrency of idea development
- Multi-task and engage more people
- Version control and information archiving

Expert 2 pointed out that there is a discreet **advantage to "going direct to digital."** Working with a remote platform forces a process

that is **"portable, archiveable, distributable, copy-able and sharable."** Remote platforms enhance the potential for **concurrent multitasking by many teammates** and **real-time sharing of information** and ideas more broadly in an organization.

Expert 1 concurred that traceability was a built-in advantage.

> *"We do a lot of collaborative sketching. There are a lot of sketches generated in one session, tons of ideas. What we used to do was do them in person and… I would be the one to log them and put the summaries into the wiki… Now we are able to do all of the generation in MURAL. So, we still do the sketches on paper but each individual needs to take a picture of their sketch but put it up into the MURAL so we can all look at it as a group and annotate it directly in MURAL with sticky notes, circle things and mark things.*
> *When we do our pitch and critique of the sketches we can record all of the feedback directly in this one MURAL. It is also something that you can go back and revisit. I think that was a huge advantage just that you are going to use less paper and keep everything in the Cloud so that everybody can access it and everybody can see it via the link." Expert 1*

Citing the Allen Curve[46], a graphical representation in communication theory that reveals the exponential drop in frequency of communication between engineers as the distance between them increases, Expert 2 noted:

> *"…when your colleagues are 200 m away your frequency of communication is about the same as if they were remote. It is not uncommon for people comfortable with remote collaboration to have an email or video chat with someone on the floor right above them. Allows you to get several people together quite quickly or two people in one building and others elsewhere.*
> *If I go upstairs and have a chat with someone, then the other people don't have the benefit of that information, but if I do it in a Slack[47] channel or an email or a MURAL, then everybody benefits." Expert 2*

Figure 53 illustrates the Allen curve.

Figure 53 - The Allen Curve. Frequency of communications decreases exponentially with distance. http://www.henn.com/en/research/organisational-structure

One advantage of remote platforms like MURAL is the **concurrency of idea development.** A group of people can all be generative on a MURAL while concurrently seeing the generative output of others. So, you can have more ideas being generated and more interpersonal

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[46] Allen curve. (2017, February 14). Retrieved February 14, 2017, from https://en.wikipedia.org/wiki/Allen_curve
[47] www.Slack.com is an internet based instant messaging and document sharing platform that works on computers and mobile devices.

inspiration than there is verbal bandwidth for everyone to hear at the same time.

A remote collaboration platform can be more effective because you can **multi-task and engage more people** concurrently.

Collaborators can capture concurrent thoughts and ideas in a virtual platform (eg twitter feeds next to a lecture presentation.) Although there might be too much information to absorb at once, it is captured in a reviewable, searchable, analyzable record.

> *"Virtual collaboration can be much more effective than physical presence because you can do several things at the same time. You can be talking on Skype, working on a Wiki document, doing a search on Google, and this can be done by a large number of people at the same time." Expert 4*

It is counter-intuitive. One might think that if you had 50 people in a room, that they might be able to interact more effectively than if connected remotely. However, this is not necessarily true. In person, it is difficult to listen to more than one conversation at a time. So, the communication is one-to-many. Breaking into smaller working groups can increase this with group ideas being shared back to the larger group. However, the use of or addition of a virtual platform like Twitter adds another channel of communication. Everyone is able to post comments concurrently to a discussion and everyone can listen to

the discussion and watch another layer or channel of thoughts and reactions in real-time...then the bandwidth of collective thinking is much richer.

This process is also very democratic with feedback in real-time shared 'many-to-many.' It allows a voice to people who might be more reserved or less inclined to contribute otherwise.

Collaboration platforms, being cloud-based, are excellent information repositories that allow real-time updating and global access. On line platforms are great for **version control**.

Tools allow you to look for skills globally and respond to immediate expertise needs quickly.

More responsive information absorption. Through using a responsive proactive database, remote team members have the opportunity to absorb and process targeted relevant project information at their own rate and timeframe as opposed to being part of a larger meeting with multiple info streams and targets.

As with remote collaboration, the enabling platforms also have some common disadvantages. These include:

- Require organizational investment
- Loss of typical forms of team spontaneity
- Impediment to live sketching inherent to in-person studio
- Loss of access to physical artifacts
- Requires cultural and personal change
- Point of diminishing return for large teams
- Trade-off in visual "real-estate" between the shared work and personal interaction (face-to-face video)

Remote collaboration platforms **require an organizational investment** in technology infrastructure (the right equipment and enough bandwidth) and development of employee platform literacy as well as literacy in the process or culture of collaboration.

At low fidelity, the technology and in particular video technology and available bandwidth have an **impact on team spontaneity** and interpersonal connection.

> *"It is actually a major limitation to only have 10 faces on a screen in a collaboration session…. present day, I find that a really big problem" Expert 3*

Video technology provides the biggest bridge to capturing the value of the social component of team creative work. But video technology currently has limitations and with this you have to question the value of having 30 faces on the screen. There is a maximum in terms of social value potential and successful interaction. There is a point of **diminishing return where adding more faces** starts to reduce the engagement and benefit to everyone.

> *"There is so much overhead associated with remote collaboration [equipment, setups, preparation, technical skill development] that you really want to make it as rich and engaged and equally contributed to as fully possible." Expert 3*

If you want to collaborate you have to have the **bandwidth.** If that is not possible, a work around is to layer the communication with a smaller group interacting through video and a broader group communicating on a message feed.

Expert 5 would suggest that there is a **lack of ability to zoom out** and see the whole picture when working on a screen as compared to a project room covered with generated artefacts.

> *"you tend to only be looking at one thing at a time…so more difficult to see patterns than if you are immersed in the artefacts." Expert 5*

Expert 5 also suggests that working remotely **requires changing how people work** and their interaction habits. This requires adoption time and effort. Furthermore, people may post ideas to a MURAL (or online information repository) but are hesitant to interact. No mixing and blending takes place so it becomes" just a repository and nothing beyond that." These are challenges to overcome.

In contradiction to other experts, what I gathered from Expert 5 is that in the context of a UX design company, where there was pressure to be cost effective and move quickly, it was great to have inclusion, but they felt they were simply more productive and more successful with the outcomes of being present than the outcomes of broader inclusion.

> *"I think when I first joined the company everybody was remote… we had remote managers… we started to bring teams together and work more intact. We experimented more with it… we just sat in our room day in, day out … focused and this is*

> *the output we had…. the senior leadership would be like "wow, you know we give this assignment for six months and you guys solve this in four weeks." So that's how we started to win everybody on board. I think we were probably three years into the transformation of moving everybody together and I would say the company is night and day, totally different than what it was with remote staff." Expert 6*

I have to balance this position with how Expert 6 framed remote collaboration:

> *"…at a global company, it's very common. I don't think I've ever been on a team where everybody is in the same building… it's almost become a way of life, in fact I've just come to embrace it and kind of at the point where I don't really see it as necessarily [an obstacle]. Expert 6*

Expert 5 also made an interesting observation about the **benefit of physical artifacts over digital artifacts.**

> *"We have visual artifacts. The team still prints everything out. We whiteboard it. We find when things are printed out and there are stickies, we don't become precious about our work. It isn't about my design or your design or your solution…it is really about how we are solving the best outcome for the customer…so if people are more prone to pick up a pen and write over it then that is how you get real collaboration. As opposed to that is your thing so I will respect it because I don't want to write over top of it…*

…When you are in person, people are able to look at other folks and everyone is listening to you, people contribute more… it feels like your idea is being heard… whereas online you are not sure if people get your point of view…People are more expressive [in person], more open to share their comments and feedback and what they would do to make improvements…and then somebody else builds on it and there is a different level of energy" Expert 5

One perspective I heard was that on-line collaboration inherently goes direct to digital which enables capturing every detail for review later; and that this was an advantage. The counter to this is the difference between formal and informal presentation of ideas. In person, you can feel comfortable to float an idea…perhaps even a bad idea or incomplete idea and if it doesn't find any traction with the group, it will disappear into the background and leave no trace. Whereas if you post an idea, it is captured for all to view and comment on. Good and bad…so **it takes more courage to post on a platform** that captures ideas. It is also more difficult to defend or explain the reasoning behind your thinking if it is criticized.

I think this is an important insight in building the competency of courage in the context of a value of trust. Also, perhaps there could be a mechanism that allows a similar convention for digitally captured unsuccessfully floated ideas to fade away.

Communicating remotely through text is becoming more and more prevalent…especially the way young people text back and forth, but from a designer's perspective at least,

"communicating ideas through text is not as rich as communicating through sketching. The ideas come out better." Expert 5

A challenge is that the tools have to be very intuitive for people to pick up and use. You have to ensure accessibility and proficiency for remote staff to feel included and on a level field.

"Staff who use design software like Photoshop, Illustrator or CAD tools will pick up the tech (platforms like MURAL) easily because the conventions are similar, but what about those who only use their laptops for email, MS office and browsing? Try teaching a marketing manager who doesn't know how to use any of these online tools. It is painful." Expert 5

Introducing / onboarding teammates to new tools has to be well thought through. Even with platforms designed with intuitive tools, platforms with many features take training and guidance to learn.

MURAL is a great example. www.MURAL.ly is an on-line collaborative tool designed to function similar to a whiteboard. MURAL enables

multiple remote users to draw, post notes and organize information in an online collaborative space.

Once I was introduced to Mural, I took the time to go through the embedded learning tools and videos MURAL provides. I have a pretty
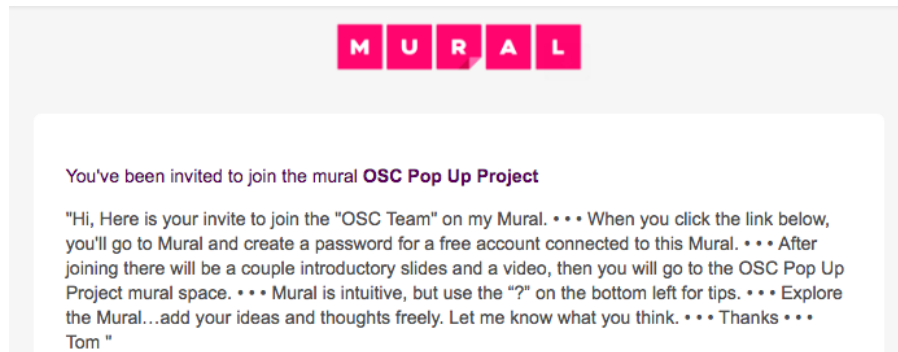
Figure 54 - - Example of improvising an upfront onboarding layer to a MURAL invite (circa 2016) www.MURAL.com

sound base in design tools and menus so many things were familiar and intuitive. I thought it was cool, so I decided I would introduce some colleagues.

MURAL gives you a process for onboarding. The first time I prepared to use it, I asked "what's going to happen when I push this button to invite someone." What will my invitees experience be if they are not

familiar with design menus? I decided to test the invitation on myself first. I did a round of testing and I found that there were gaps.

MURAL has a simple pop up panel to invite someone by email. Back in 2016 the onboarding had some drawbacks. Your onboarding message was limited to a few sentences in one paragraph so it was not easy to set up a project introduction or instruction list. This has since been improved.

I found it necessary to build my own layer of onboarding in front of the MURAL invite to give my colleagues a step by step process of what they should expect once they accept the link to join…including a head's up that they would have to create an account to see my MURAL.

The other drawback was that new invitees to a MURAL, first had to undertake an account setup process and watch intro videos. This time commitment took away from the opportunity to immediately see relevance to the target MURAL.

This also has now been improved to allow a new user to go directly to participate in a MURAL. Users are now encouraged to eventually create their own account to have access to features like downloading. Video tutorials are available in a help menu.

One improvement that might still be added is to highlight the Help menu with a pop-up bubble.

What is important ultimately is the simplicity and immediate potential for adoption and recognition of value when onboarding new members to a platform. As with MURAL, testing and iteration to improve this function is critical.

🗎 Pros and Cons of building a single platform

Expert 3 noted that over the course of a project, the team changes, the needs change and the tools required change. A mashup of tools essentially becomes a suite. To help remote teams succeed, a checklist of tools was provided as well as templates for where to put platform components on the screen. Providing a pre-considered "designed" solution saved team members time and provided consistency.

Expert 7 suggests not being married to a specific set of remote collaboration tools.

> *"The problem that I see with an integrated platform is that every industry and every team has a unique set of needs…a unique style how they want to do this work…*
> *Different solutions for doing calls, video calls, screen sharing, posting work, receiving comments on work…. like having all those different tools at my disposal because I can be deliberate about what I pick." Expert 7*

The tools are always evolving, so you want to follow the innovation of the best tools and **be flexible in adopting new tools**.

Counter to this might be the anxiety associated with constantly changing tools and the potential complexity and loss of productivity associated with each new learning curve. From a human perspective, where does proficiency and productivity in a set of integrated tools trump the complexity of changing to the latest non-integrated innovation?

Figure 55 illustrates the system influences underlying the debate for use of integrated or non-integrated functionality within a theoretical platform. At what point does the integration become so complex that it isn't feasible?

Figure 55 - System Map examining relationship of adding features to an integrated platform and the ROI.

Figure 56 - This graph postulates the relationship between increasing integrated features and the resulting productivity and complexity. Discovering if these lines actually intersect would take additional research.

Figure 56 postulates that at some point added complexity will negate productivity benefits of additional features.

Expert 4 conveyed the experience of trying to pull together a large global, multi-cultural team of collaborators. LinkedIn, Dropbox, Skype and email were combined to create a shared platform. Expert 4 noted that there was a reluctance by some to adopt LinkedIn either because it required a significant investment to adopt, or because it connected to other aspects of their profession.

In the context of creating a platform for a specific development function targeting a broad user group (as will be proposed later), I would suggest that the platform include integrated components that provide a consistent and planned environment suited to the needs of the work to be done.

...

APPENDIX F – CLOUD-BASED REMOTE COLLABORATION PLATFORMS, APPLICATIONS AND TOOLS

Legend: ● Primary Function · ◉ Available integration · ◎ Limited / Possible workaround

Functionality Taxonomy (column groups): Infrastructure · Information Repositories · Communication · Coordination · Generative Systems · Idea Management

Platform Taxonomy	Description	Web-based platform	Security	Work process integrated	Manage Users	Membership in a collective	Member Profiles	Advertising	Sponsors	File storage	File sharing capability	Code repository	Information posting	Journals	Searchable information	Instant Messaging	Chat tools	Comment / Discussion	Email	Blog	Phone / voice	Conference Calls	Video Conf. Integration	Prompts to participate	Team online awareness	Screen sharing	Voting	Web conferences	Tracing threads	Alerts to changes	Track the evolution	Work Process Guidance	Progress tracking	Project Mgmt features	Notification / Alerts	Team dashboards	Checklists	Shared calendar	Concurrent doc co-creation	Shared visual workspace	Whiteboard	Live Sketching	Shared Wiki	Project Templates	Iteration tracking	version control & commenting	Idea / Contribution Ranking	Creator Tracking	Brainstormin	Collaboration	Reward system
Communities of Practice																																																			
www.ExhibitFiles.org	A community site for exhibit designers & developers to share advice, case studies, reviews & best practices.	●	●		●	●	●			●			●				●		●								◎																								
www.astc.org/	An association website for Science and Technology Centres	●	●			●		●									●		●																																
www.name-aam.org/	An association website. NAME is a Professional Network of the American Alliance of Museums.	●	●		●			●						●																																					
Information Sharing Repositories																																																			
Google Drive / GoogleApps	A cloud based file storage / sharing system & document software	●	●		●					●	●					◎	●								●													●	●	◎		◎		◎							
www.dropbox.com	A cloud based file storage / sharing system integrated with MS Office 365 document software	●	●		●					●	●						●							●					●	●									●	◎	●	◎			●	●					
Box.com	A cloud based file storage / sharing system integrated with MS Office 365, GoogleApps, Slack, SalesForce, Redbooth and others	●	●		●					●	●	●	◉	◉	◉	◉	◉	◉	●	◉					●	●	●		◉	◉	◉	◉	◉	◉	◉				●	●		●			●	●					
EverNote.com	write notes, clip images and pages, organize in cloud, share, search text	●	●		●					●	●	●				●	●													●									●	◎	●					●	●					
Communication Channels																																																			
www.Skype.com	Video Conferencing, presentation and Screen sharing	●	●								●					●				●	●	●		●	●																										
www.GoToMeeting.com	Video Conferencing, presentation and Screen sharing	●	●								●					●				●	●	●		●																										
www.Google Hangouts	Video Conferencing, presentation and Screen sharing	●	●								●					●				●																														
www.Zoom.com	Video Conferencing, presentation and Screen sharing	●	●								●					●				●	●	●		●																										
www.Slack.com	Messaging, document sharing	●	●		●					●	●			●		●	●	●		●		●	●		●				●	●				●																	
Project Management																																																			
www.Trello.com	Trello's boards, lists, and cards enable you to organize and prioritize your projects https://trello.com/ 5 March 2017	●	●		●					●						●	●	◎				●	●						●	●	●	●	●	●	●	●	●													
www.Redbooth.com	"Redbooth is easy-to-use online task and project management software for busy teams." https://redbooth.com/ 7 Feb, 2017 Wide range of information sharing and PM features. No whiteboard, limited real-time interaction for collaboration	●	●								●		●			◉													●	●	●	●	●	●	●								●	●					
www.Taskworld.com	connect team memebers, use visual boards, organize projects, share ideas	●	●		●					●	●					●	●	●	●			●	●					●	●	●		●	●	●	●															
www.GitHub .com	"GitHub is a web-based Git or version control repository and Internet hosting service....It provides access control... bug tracking, feature requests, task management, and wikis...[3]" https://en.wikipedia.org/wiki/GitHub 7 Feb. 2017	●	●			●	●			●		●			●	●	●					●	●					●	●	●		●	●	●								●							
www.BaseCamp.com	organizes communication, projects, and client work in one central location	●	●		●	●				●	●		●		●	●	●	●									●	●	●	●	●	●	●								●	●					

Figure 57 - Assessment of Cloud based platforms, applications and tools for Remote Collaboration. Part 1 of 2

Functionality Taxonomy

Legend:
- ● Primary Function
- ◉ Available integration
- ◎ Limited / Possible workaround

Column groups (left to right):

Infrastructure: Web-based platform · Security · Work process integrated into platform · Data analytics and processing · AI analytical processes and supports · Manage Users · Membership in a collective · Member Profiles · Advertising · Sponsors

Information Repositories: File storage · File sharing capability · Code repository · Information posting · Journals · Searchable information /database features

Communication: Instant Messaging · Chat tools · Comment / Discussion capabilities · Email · Blog · Phone / voice integration · Conference Calls · Video Conference Integration · Prompts to participate · Team online awareness · Screen sharing applications · Voting · Web conferences · Tracing threads · Alerts to changes · Track the evolution, traceability

Coordination: Work Process Guidance · Progress tracking · Project Management features · Notification system / Alerts · Team dashboards · Checklists · Shared calendar

Generative Systems: Concurrent document co-creation /editing · Shared visual workspace · Whiteboard · Live Sketching · Shared Wiki · Project Templates · Iteration tracking · version control & commenting

Idea Management: Idea / Contribution Ranking · Creator Tracking · Brainstormin · Collaboration · Reward system

Platform Taxonomy	Description
Integrated Enterprise System	
Microsoft Office 360	A suite of integrated apps with web-based communication, sharing and task management capabilities
Co-creation platforms	
www.Mural.ly	On line white board with process templates
www.Padlet.com	Posting and sharing information on a large online board
www.Stormboard.com	On line white board with process templates
www.ConceptBoard.com	On line white board with process templates, Video chat & Trello integration,
www.BoardPaq.com	cloud service & apps for planning, running and managing paperless meetings
Dedicated Co-creation enterprises	
www.Quirky.com	Product development collective. Members put forward ideas for products. Community works together to access & develop concepts through various stages, voting at key points. Members gain a stake in the project through contributions. Quirky core team takes successful project through to market. Offers products for sale through site. Each product tends to have a single owner of the idea.
www.Shapeways.com	provides on-line tools to create 3D printed objects / products and the infrastructure to market and sell them.
www.Secondlife.com	Virtual world for meeting and building (requires intense computing power)
Crowd Sourcing Enterprise	
www.Reddit.com	a bulletin board system where members up or down vote on posts so that the most popular posts move higher and get more exposure.
www.zooniverse.org	crowd-sourced research analysis
www.yelp.ca	crowd-sourced restaurant reviews with commenting and ranking
Idea & innovation management software	
www.Spigit.com	an innovation management platform that enables crowdsourced idea generation from the employees, partners and customers.
http://crowdicity.com	used to engage employees, partners and customers in problem solving
www.brightidea.com	track the development of ideas and evaluate their viability
www.Betterific.com	"Betterific crowdsources innovation; bringing together a community of innovators and idea people, to unearth ways to make things (products, services, brands) better. Betterific was built to open up the product innovation conversation and connect brands and consumers over ideas." https://betterific.com/feeds/ideas/faqs 7 Feb, 2017 Seems like a very limited platform. Twitter-like responses to simply defined problems. Solely written. No opportunity to use visuals. Limited ability for collaborative thinking, layered information or iterative work.

Figure 58 - Assessment of Cloud based platforms, applications and tools for Remote Collaboration. Part 2 of 2

APPENDIX G - INSPIRATIONS AND POTENTIAL INNOVATIONS

This research project often felt like a large jigsaw puzzle. Sorting through the many puzzle pieces, some could be identified as individual problems to solve on their own. For example, one could identify that a weakness in the system of remote collaboration was the loss of in person communication cues...and wonder: How does one improve this important component?

Throughout my research, I kept an idea book to capture inspirations and potential innovations that would present themselves as my mind processed these problems in the background.

This Appendix documents some of the innovation inspirations captured through the process of researching and evaluating different remote collaboration tools and methodologies. Some of these innovations laid the foundation for the possibility of a new type of platform for collaborative co-creation.

The technology for most of these ideas exists already and for the others the technology will soon come along. With each improvement in technology and increase in bandwidth, remote collaboration will move towards in person collaboration in terms of personal connection.

Our ability to identify and mitigate process challenges sets an inevitable trajectory for change in the way we work and learn and how we will take advantage of the potential of a globally connected population.

These conceptual innovations reinforced my belief that the remaining draw-backs of remote collaboration will eventually dissipate. As this happens, platforms such as the one I envision in **Chapter 7** and **Appendix K** will become completely realizable.
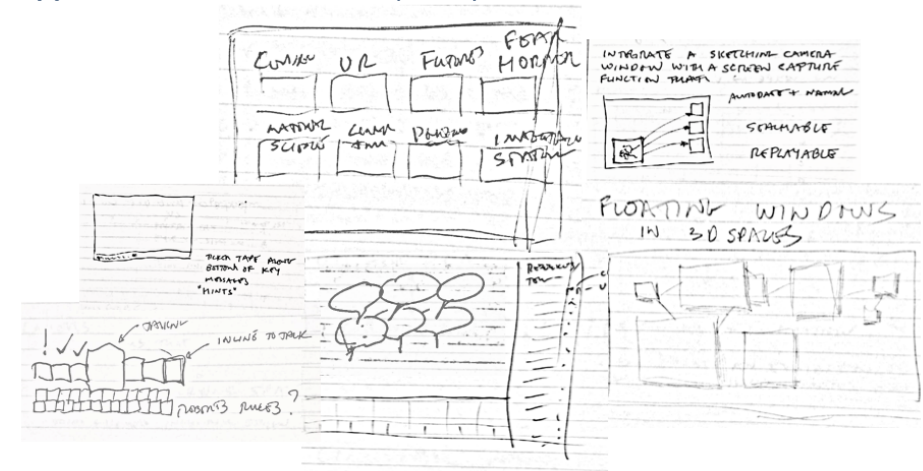
Figure 59- A selection of sketches from my idea book

Process Guidance · Shared Doc · Shared Whiteboard · Process Guidance Ticker Tape · Sketch Cam Window · Sketch Cam Capture List · Chat Feed

Selfie-Cam Headset

AI Instant Messaging & Chat Manager (parsed key themes and word cloud)

Live Sketch Tablet
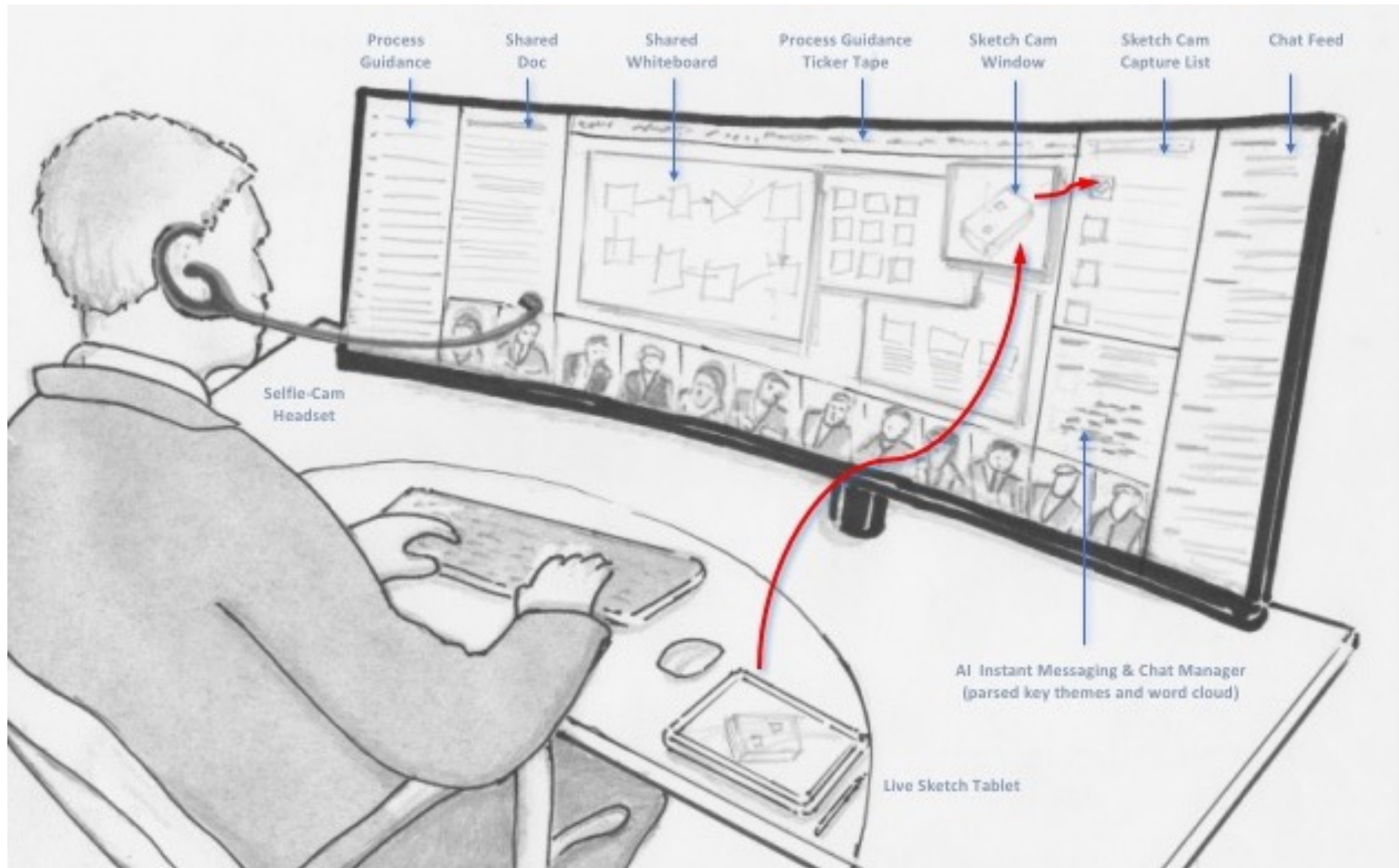
Figure 60 - Co-Creation Station illustrating potential innovations. T. Kasanda

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Location aware audio projection

As technology and bandwidth improve, it will be possible to increase the number of active participants in a video conference. Participants could be spread out across multiple screens or one large screen. To facilitate realistic face-to-face conversation, it would be useful to have an intelligent system that adjusts stereo output to simulate voice audio coming from the same location as the speaker's video window on the screen. See Figure 60 and 61.

Location Aware Audio Projection would act as an additional cue to the user to face the colleague they are speaking with. This would work well in conjunction with the head-mounted selfie-cam proposed in 5.7 below.

AI Instant Messaging and Chat manager

The human brain captures information in short term memory and transfers it to working memory for processing. Each of these structures has capacity limits.

As artificial intelligence (AI) capabilities progress, at some point AI will be able to manage and enhance the absorption of the large amounts of communications data co-created by large teams. This might entail filtering and consolidating multiple messaging and chat feeds to provide aggregated thoughts and team consensus. I could imagine the display of a real-time word cloud that synthesizes collective thoughts and ideas being concurrently shared.

Alternatively, AI might be able to identify and promote key messages or voices from a large collective that are in-the-moment pertinent to a live discussion or decision-making gate.

AI might sift through, find and display non-linear paths through blog and chat postings that would link/juxtapose relevant discussion content in ways that might be missed through linear review.

See Figure 60 and 61.

Large group web cam manager

As band-width increases, it will become possible for more and more participants to join a video conference. I believe there would be value in an intelligent hierarchical organization of webcam feeds. The active speaker is centered and magnified. Active participants are displayed at a primary level. Multiple passive participants could be represented with smaller thumbnails. Integrated pop-up emoticons might provide an additional visual feedback layer that compensates for some of the missing in-person 'reading of the feel of the room.' There could be a possible cue to speak function. See Figure 61.

Figure 61 - Dashboard and Video Cam Manager Concept. T.Kasanda.

Pop up Emoticon feedback

One of the drawbacks of remote meetings is the difficulty of sensing the flow of the conversation.

> *[on line]" You just don't know when someone is paused or when they're finished so you can't see where someone is at in expressing their thoughts… [In person] when someone's completing a thought you can make a movement and people will look at you and they can tell that you want to say something and they might acknowledge you in." Expert 1*

Finding a way to overcome this remote meeting challenge would improve communication. Initially I thought an on-line discussion version of Robert's Rules of Order might be helpful. Robert's Rules of Order is a set of procedural rules that manages large group discussions such as those in Parliament and other governing bodies.[48]

Another option considered was a set of emoticons that might be integrated into video chat allowing more recognizable conversation cues…perhaps numerically prioritized by order or emphasis.

This could be especially useful if bandwidth didn't allow for video chat, but people on a conference call could show up as icons along the bottom of a MURAL or shared screen.

In prototyping the idea, I saw that emoticons had the potential to create visual clutter. In Figure 61, I simplified the idea to coloured dots indicating the level of "concurrence" in an ongoing discussion as well as a question mark to indicate a desire to break in with a question or important comment.

In some cultures, a person holding the "talking stick" has the respect and attention of the group.

This online collaboration feature for conference calls could include a "Taking-stick" like quality where someone can "in turn" request the "floor" or "microphone" of the discussion.

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[48] Robert's Rules of Order. (2017, August 14). Retrieved September 02, 2017, from https://en.wikipedia.org/wiki/Robert%27s_Rules_of_Order

Integrated sketch camera screen capture and annotating function

Expert 3 spoke of using the IPevo camera to share a view of live sketches during on line work sessions. To improve the 'direct-to-digital' nature of this process, a pop-up window that shares sketch camera contents could have an integrated screen capture function. Screen captures move to virtual whiteboard and self-organize for comment. Auto-time-stamped. Voice-to-text tagging. Archive-able, searchable, re-playable.

See Figure 60 and 61.

Integrated "Tickertape" process hints

During remote team exercises, a "tickertape" feed at the top or bottom of the team work dashboard could provide on-going informational dynamics of the process or commentary.

See Figure 60 and 61.

Selfie-Cam headset

As technology increases potential bandwith and large screen interfaces become more common, it will be possible to engage a larger number of remote live participants. With the goal of making remote interactions as 'present' as possible, a properly positioned miniaturized headset selfie-cam will optimize the face to face nature of online conversation. This technology will allow the user to always appear forward facing to colleagues regardless of where on a large screen they might appear. See Figure 60.

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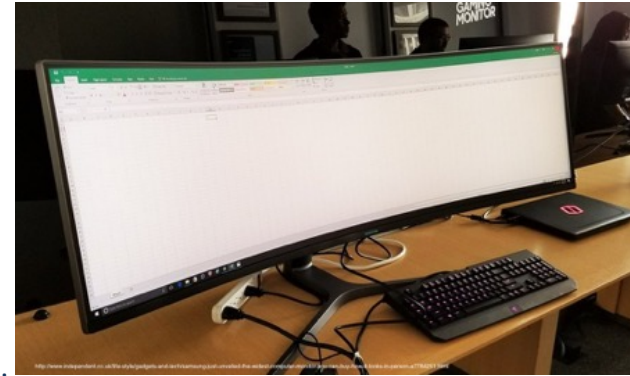
Figure 62 - Samsung 49-inch CHG90 super ultra-wide gaming monitor is an example of an extremely wide screen interface where a selfie-cam would help to maintain face-to-face interactions with many faces on a screen.

Image Source: http://www.independent.co.uk/life-style/gadgets-and-tech/samsung-just-unveiled-the-widest-computer-monitor-you-can-buy-how-it-looks-in-person-a7784251.html

Selfie-Cam algorithmic video optimization for bandwidth reduction

Intelligent video processing and green-screen technology can extract the most important selfie video data. A Face can be placed in front of virtual background that is pleasing and reduces the clutter typical of a home office. With 'selective compression', bandwidth requirements can be reduced while increasing the fidelity of the face to face cues.

Layer control

Similar to AutoCAD and Adobe Illustrator, layer control would help manage and organize information. In addition, layer control would manage visual overload by turning off layers of information that are unnecessary for different parts of a process. It might also lock certain layers such as template underlays so that they are not selectable or delete-able. See Figure 63.
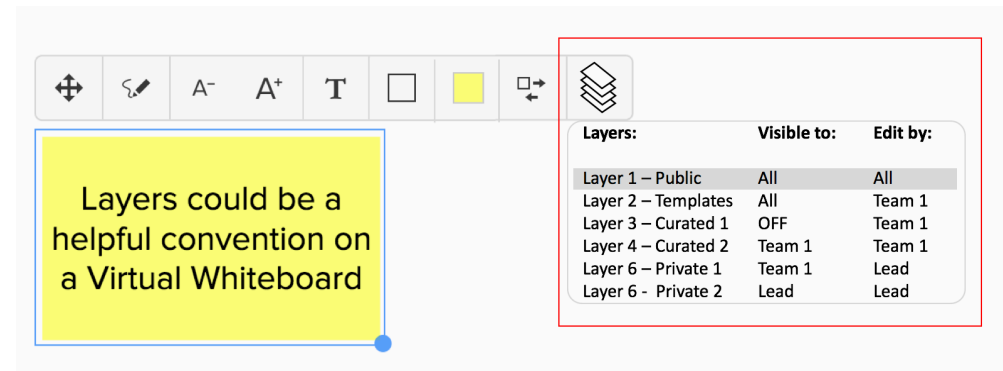
Figure 63 - Example of how Layer Control could be added to a typical MURAL property menu. Original Image Source: MURAL.com

Grid location system for large virtual white boards

A keyboard or voice command toggles on and off for an over-laid addressable map grid. Input coordinates take an individual or entire remote group to a specific location on a virtual shared whiteboard.

a) to direct attention on a large virtual whiteboard

b) Toggle grid on

c) Zoom to "F3." Toggle grid off.
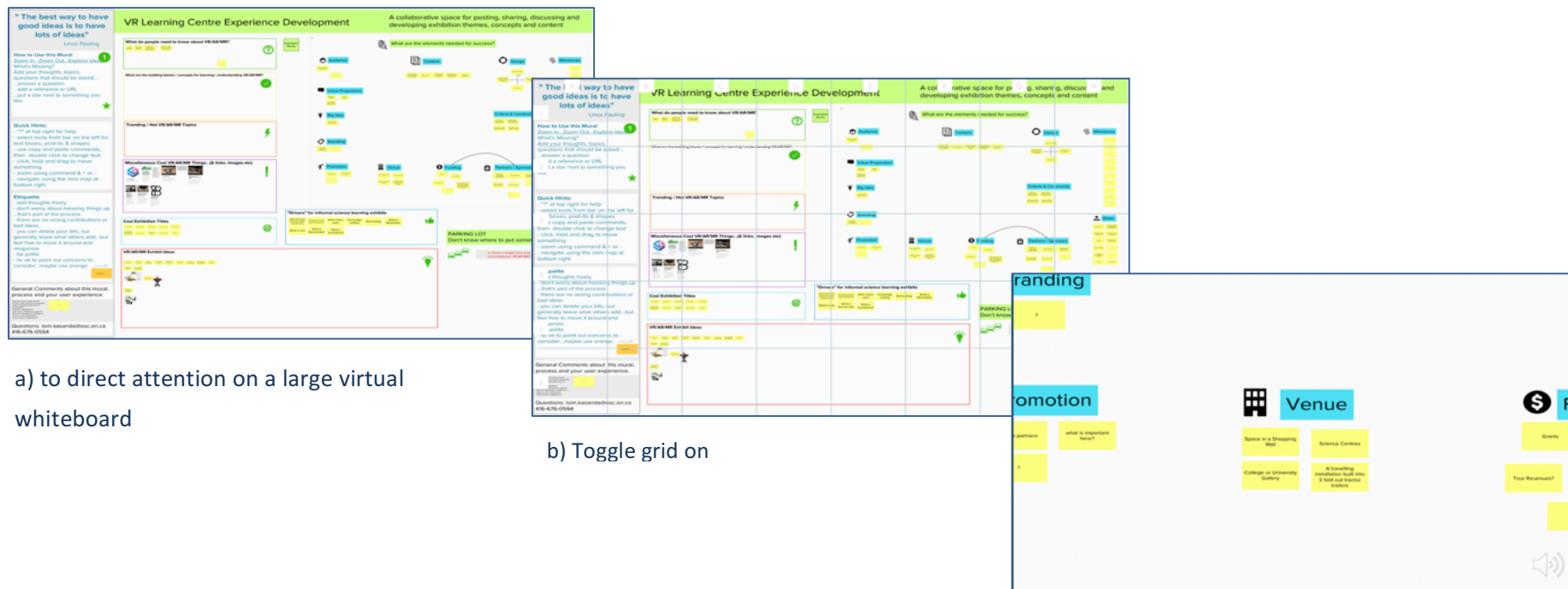
Figure 64- Grid Location System for large virtual whiteboards

Mirrored group window control

A keyboard or voice command automatically reorients all remote participants to the same view of a virtual whiteboard as the active participant. A function like this allows the group to focus on a particular aspect of the task at hand. This is different than screen sharing because everyone maintains their ability to work, add to and comment on the shared area of the shared space.

Collapsible side panes and windows on virtual white boards

As with AutoCAD and Adobe Illustrator, user created collapsible side panes and windows would help with visual space management and information accessibility. A work check list or process hints and guidelines could be quickly accessible on a side pane for quick access at a proper scale without zooming out or opening a different program window.

Intelligent live document windows management

Many projects, including exhibition projects, require the development of hundreds of inter-related documents. Work on one document requires knowledge of and access to either parent or dependent files, or project wide specifications and data. These documents are created in a range of programs (word processing, spreadsheets, drawing, graphic, code, photographic, rendering, etc.)

An intelligent system could assist remote workers in accessing the correct range of required documents for a particular task and organize them on a desktop in a way that improves productivity. With cloud based programs and documents, everyone on a remote team can have access to the same programs and documents.

 The system could also provide an integrated communications system that would open the related chat and task lists as well as connect in the most appropriate remote team members with the right skill sets for a particular phase of work or work sprint. This could prove particularly helpful when coordinating the efforts of crowd-sourced volunteers to simplify onboarding, learning curve and work-flow.

Figure 65 illustrates some of the characteristics of such a system.
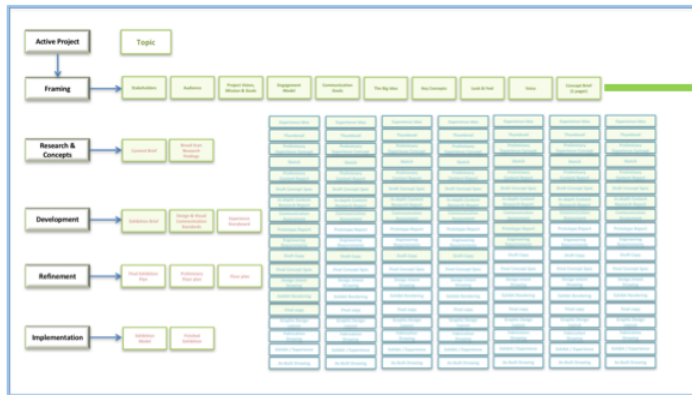
From a visual representation of the process and document database, teams can be guided through critical information to a specific work requirement. Conventions such as green shading might indicate work that is complete and approved.

Buttons for Tasks, Mural or Chat open windows for information and workspaces connected to every document or work process so that current or previous work history can be reviewed.

An on-line work sprint to generate ideas on a Mural is guided by Communications Goals and Key Concepts that have already been established.

Figure 65 - Intelligent live document windows management concept

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Intelligent information management systems have the potential to enhance human productivity, removing organizational drudgery and allowing people to focus on more rewarding creative or analytical tasks.

Perhaps Zooniverse.org.is a precursor to the potential of such systems. Zooniverse engages crowd-sourced volunteers to process large amounts of interesting data that is not suited for computer-based examination.

In one example Zooniverse project, "Backyard Worlds: Planet 9," thousands of web-based volunteers were automatically presented millions of sets of star-field images and asked to observe and categorize specific characteristics in the search for new objects at the edges of our solar system.

Currently, computers are not successful at the kind of visual analysis required to observe changes in successive images of star fields, but humans are. A computer based system selects and presents sets of star fields for analysis. It turns out volunteers interested in space enjoy the challenge of searching for anomalies in star fields and the excitement of possible discovery.

The project has already identified twelve brown dwarf candidates and one verified brown dwarf largely due to a crowd of volunteers and an automated method of sharing correctly correlated sets of image documents.[49]

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[49] Zooniverse. (n.d.). Retrieved August 02, 2017, from https://www.zooniverse.org/projects/marckuchner/backyard-worlds-planet-9

APPENDIX H - THE NEW MODEL FOR SCIENCE EXPERIENCE CREATION

FLASH-BACK

About 20 years ago, the Ontario Science Centre added its first open conference to the internal email system. I remember immediately thinking that this was an amazing opportunity to tap into the broad creativity of my colleagues. At the time "Extreme" was the new catch word. "Extreme Sports" were a novelty. I had a simple idea to capitalize on the market recognition to create an exhibition called "Extreme Science." I decided to use the new conference to solicit ideas from across our organization for content that would fit within this theme.

I received ideas from across the organization, not just scientists and designers, but hosts, security guards, and accountants. Within two weeks I had enough ideas to frame out a cool exhibition. At the annual ASTC Conference, on our product survey, seven museums indicated they would absolutely rent the exhibition, and eight indicated they likely would take it. The break-even point was seven. Unfortunately, the concept never moved forward, largely due to the structure and

failure points revealed in Figure 2. But even 20 years ago it seemed apparent that soliciting the crowd had amazing potential.

Flash forward.

THE OPPORTUNITY TO REPOSITION

The expansion of the Informal Science Learning market in a distributed global fashion, the need for science literacy in a rapidly changing world, emergence of collaborative online tools and the potential to combine crowdsourcing and learning experiences creates the possibility of a new business model built on remote based co-creation, shared development resources, shared ownership and local production. This model could create more affordable exhibitions if optimized for the requirements of the exhibition development process. Figure 66 shows how this change could reposition the current typical exhibition development process.

Using the previously noted innovation opportunities, Figure 67 illustrates how using an integrated process co-creation platform will transform the typical model for creating exhibitions for science centres from a hierarchical closed marginally responsive system to a relatively flat, open, distributed system driven by and responsive to the collective of distributed stakeholders.

Inherent in this proposed shift are two requisite principles:

1) An organization such as a science centre that adopts this methodology is undertaking to flatten its hierarchy by inviting "the crowd" to participate in idea generation, influencing decision-making and real co-creation.

2) For this to succeed, there has to be a strong belief and commitment to embrace the "wisdom of the crowd," in order to be true to the required cultural value of egalitarianism. It is likely that crowd members would quickly lose commitment if the perception arose that decisions were driven more by corporate or management interests.
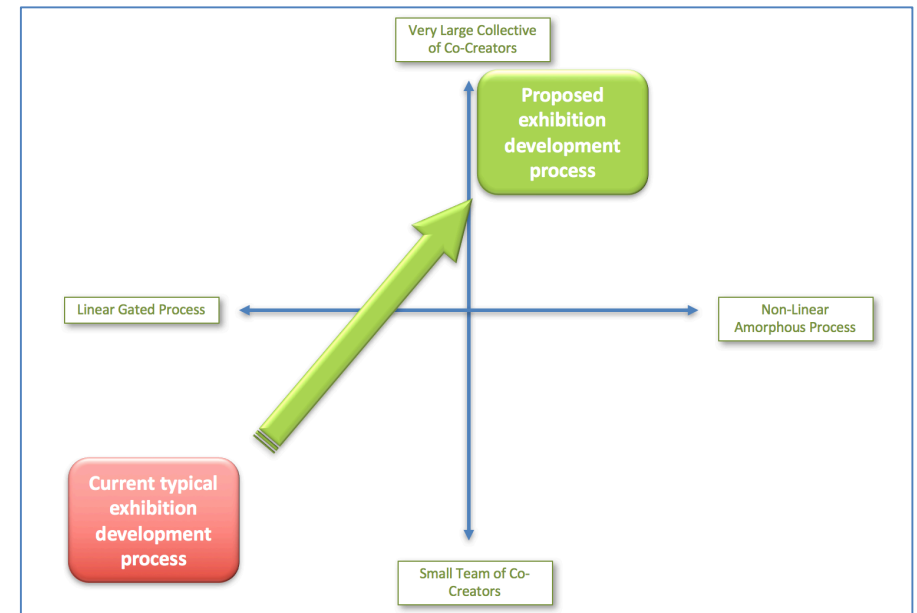
Figure 66 - Repositioning the current typical exhibition development process.
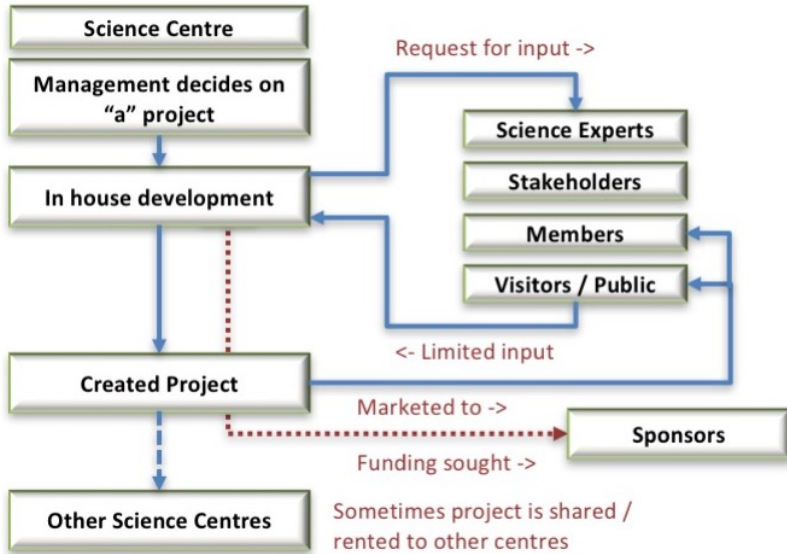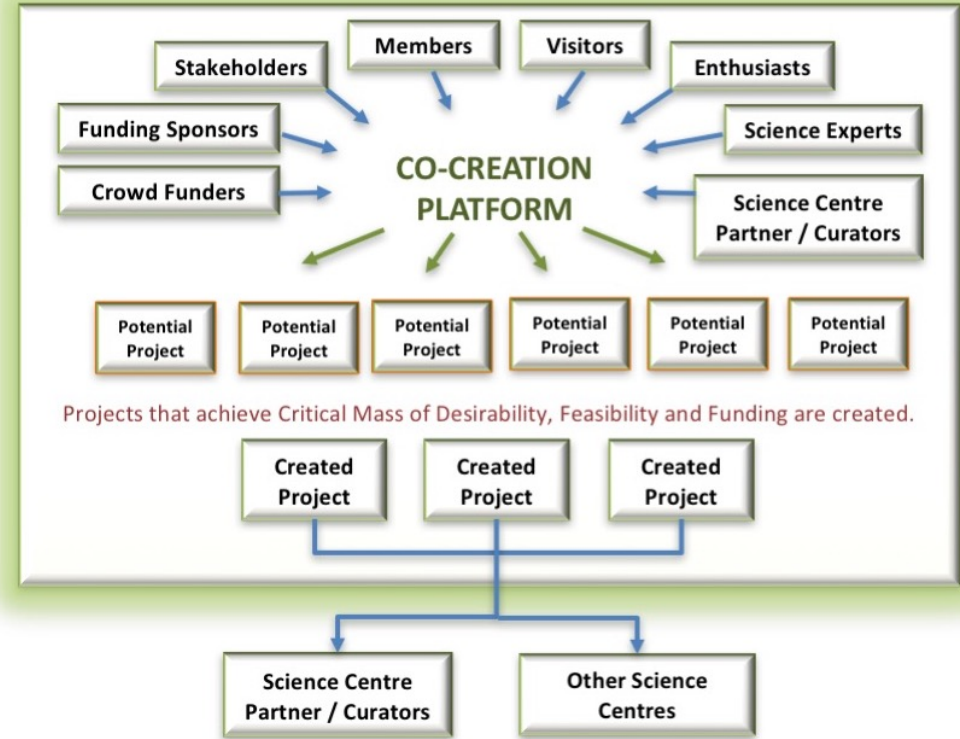
Figure 67 - Comparison of old model for exhibition development and new proposed model.

POTENTIAL CUSTOMER SEGMENTS

I have identified three suitable customer segments that could be engaged in this new business model. These are:

❑ Science Enthusiasts – interested in exchanging ideas and increasing science understanding; also enjoy participation in a creative endeavor like an interactive exhibition.

❑ Science Centres – interested in engaging the public in science learning and understanding; looking for more cost-effective ways to create new experiences and enhance their public offering.

❑ Exhibition Development Consultants – interested in effective methodologies to expand their consultancy capabilities; wish to expand their abilities to work with international clients and distributed remote teams of experts; wish to expand ability to capture market research.

Appendix D illustrates Value Propositions for these segments.

FOUR POTENTIAL BUSINESS MODELS

The development of a Co-creation platform for exhibition development could fall into several different business models:

Open-source, community-driven

- The platform would allow a global community to contribute as the research and idea generation engine to build a critical mass of conceptualization leading to a concept brief.

- Similar to the KickStarter.com model, viable concept briefs could be shopped for funding either by a sponsor or pre-sold to institutions.

- Alternatively, as an open-source creation, any member or group of members or institution could choose to take the project to realization locally.

- Funded by micro-fees or donations, advertising and/or sponsorship, philanthropy, pre-sales of exhibition visits, pre-sales of an informative exhibitions guide and home activity book.

- This model might also be suitable for creating an entirely virtual exhibition experience where the complexities and highly technical management of physical prototypes and manufacturing would not

be required. This could possibly be built and even monetized within an existing virtual world like SecondLife.[50]

Crowd-sourced, community-driven, professionally curated

- In this model, an institution could engage stakeholders, subject matter experts and their public in the development of a project.
- A templated and gated process maximizes the value of crowd-sourced ideas and feedback. Professional curation provides quality control, project management and an implementation capacity for creating a physical exhibition.
- Funded by sponsorship, philanthropy, institution attendance revenues, and tour revenues.

A personal business tool for my own consultancy

- Used to reach and interact with international clients.

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[50] SecondLife.com is an example of an on-line virtual world with over 1 million users monthly. Users both explore, interact with other users through avatars and may participate in building and creating within the world. Second life has an economy and virtual goods and services can be created, traded and monetized.
Jana, R. (2006). *Innovation & Design, Starwood Hotels Explore Second Life First.* Retrieved from *http://www.bloomberg.com/bw/stories/2006-08-22/starwood- hotels-explore-second-life-first.*

- Maximize client participation and engagement of their stakeholders.
- Value in enhanced productivity, global reach to clients.

A subscription based enterprise

- Offered for use to a commercial company, possibly an exhibition design-build company looking to optimize its processes and remote client interaction, or a consortium of science centres desiring to collaborate more effectively.
- Generates subscription fee revenue
- Each of these categories has the potential to provide value and self-sustaining revenue. **Appendix J** illustrates a potential business model using a business model canvas.

Of the four models, "Crowd-sourced, community-driven, professionally curated " seems like the most flexible starting point to build a model. It reduces some of the complexity of a fully community driven platform but still lays the foundation for the other models noted.

INNOVATION OPPORTUNITIES

In Figure 68, using Doblin's Ten Types of Innovation as a reference for business model innovation, I have identified nine potential innovation opportunities. Each of these business model adjustments can create opportunities for competitive advantage and suggest a potential disruptive model for creating informal science learning experiences.
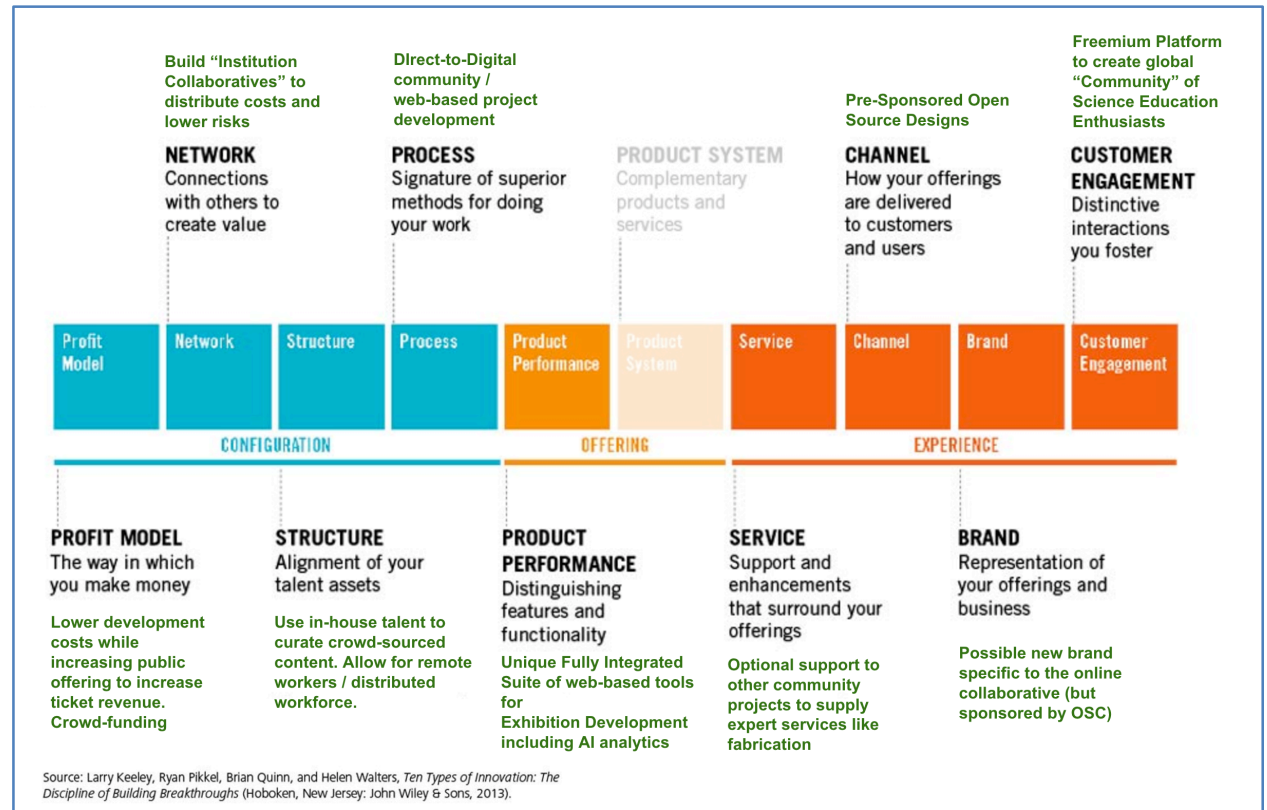
Figure 68 - Identification of nine potential Innovation Opportunities

Figure 69 - Value Proposition Diagram for Segment #1 - Science Enthusiasts

Figure 70 - Value Proposition Diagram for Segment #2 - Science Centres

Figure 71 - Value Proposition Diagram for Segment #3 - Exhibition Development Consultants

APPENDIX J - BUSINESS MODEL CANVAS FOR NEW INFORMAL SCIENCE LEARNING BUSINESS MODEL

Key Partners

- ASTC
- National Science Foundation

Key Activities

- Platform Development
- Admin / Platform Management
- Project / Workshop / Activity Management
- Sales
- Sponsorship Development
- Membership Management / Support

Key Resources

- Co-Creation Platform
- Crowd-based participants
- Curating Expertise (IP)
- Program Managers
- Office space
- Knowledge Base (Library & Network)

Value Propositions

Participate with other science enthusiasts and institutions in sharing ideas and creating interesting science learning experiences. Build teams and get funding.

A co-creation platform with customer engagement, project development tools, mentorship and support to create exhibitions more efficiently and cost-effectively.

Increase competitive advantage & A platform for engaging clients and their stakeholders to create exhibitions more efficiently and cost-effectively. Engage the public for feedback and market intelligence.

- Access to market segment interested in exhibition services
- Association, positive impact on areas of interest
- Expert delivery of societally valuable platform in support of informal science learning

Customer Relationships

- Community
- Self Serve / Personal Assistance
- Self Serve / Personal Assistance
- Self Serve / Personal Assistance
- Personal Assistance
- Personal Assistance

Channels

- Website
- Website
- Website
- Website
- Direct Sales
- Grant Application

Customer Segments

1. Science Enthusiasts
2. Science Centres
3. Exhibition Development Consultants
- Advertisers
- Sponsors
- Grant Providers

Cost Structure

- Staff costs
- Equipment fees
- Web Hosting
- Rent
- Platform Development
- Advertising

Revenue Streams

- Free / Fees for advance features — Fees
- Free / Fees for advance features — Sponsors Fees
- Free / Fees for advance features — Grants

www.businessmodelgeneration.com

Figure 72 - Business Model Canvas for Science Exhibition Collaborative

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APPENDIX K - DESIGN PRINCIPLES FOR REMOTE COLLABORATION PLATFORM

Ultimately, the user experience is critical and will make or break the success of any co-creation platform.

The following questions were considered:

(D1.) Who is the target user?

    a. Target users will include science content experts, designers, stakeholders like sponsor representatives and a broader public collective. They will typically be socially-minded, curious, artistic, educated, interested in science and public education.

    b. The target user could also be anyone wanting to form a team of remote collaborators to undertake a problem-solving project.

(D2.) What design aesthetic will suit the user and the project?

    a. Functional, easy to navigate, visually engaging through curious imagery and thought-provoking questions.

(D3.) How can the user interface be structured for quick and easy uptake and onboarding?

    a. Minimize the initial on-boarding / registration process

    b. Allow users to explore project work in progress

    c. Some limited contribution access prior to registration

(D4.) What participation elements will create engagement and a desire to contribute?

    a. Posting stickies and comments

    b. Giving and receiving acknowledgement of contributions

    c. Tracking of top contributors

    d. Option for Co-creator profile

(D5.) How can the process create "Agency" (empowerment, ability to achieve and satisfaction)?

    a. Build sense of community by implying a cultural framework and providing a space for sharing interests and interactions.

    b. Provide the framework and tools that allow egalitarian success to take root and flourish.

    c. Profile collaborative successes to inspire the community.

(D6.) Is there a sweet spot between allowing agency and balancing management towards a defined goal or success criteria?

   a. Build a solution that is flexible and allows variability with respect to professional or curated guidance in relation to the needs of the project and the community that is allowed to evolve. Support could include:

   b. Questions or hints

   c. Activity Prompts

   d. Guided work sessions or task requests

   e. Sometimes a mass of work will require a curated synthesis, but it is important this be played back to the community for review

PROPOSED PLATFORM DESIGN

The proposed collaboration platform will encapsulate a harmony of Culture, Process and Infrastructure. Figure 73 illustrates the framework for these three requirements showing subcomponents and critical elements.

Culture (D1, D3, D4)

Engaging a community of Co-creators is most likely to succeed when there is:

❑ A shared sense of vision, purpose and goals.

❑ A culture built on embracing values of trust and respect.

❑ Respect for the value of diverse opinions, disciplines and perspectives.

❑ Respect for the value of listening. This is both having the patience to listen as well as valuing the action of listening by others.

❑ Acceptance of respectful dissent - Embrace dissent as an important counter to group think and look for underlying issues and blind spots in the evolving project.

The community should recognize the platform as being a place where people can share their ideas and provide critique with understanding and expectation of mutual prosperity through the benefits of co-creation, diversity of thought and improvement through critique.

Process Requirements

❑ A simple to follow process that is easy to onboard and easy to participate in.

- ❑ A semi-linear methodology with templates and guidelines. Although the process generally moves forward, iteration needs to be built in.

- ❑ Process for co-creation of work, feedback and critique.

- ❑ Allowances for individual contribution and group work sessions.

- ❑ A structure that allows subject matter experts, professional exhibition developers and a broader public community to interact and contribute.

  Infrastructure

- ❑ Web-site based development platform

- • Landing page (D3)

- o About
- o Charter of Values
- o Process / Methodology explanation
- o Knowledge Base
- o Exhibit Database
- o Registration / Membership
- o Project Incubator
- o Project Dashboards

- • Project Incubator (D5)

- o Collaborative online whiteboard
- o Place to share ideas, philosophy, criteria for new projects

- o Place to incubate a critical mass and following to initiate a project
- o Link to crowdfunding integration
- o Start new project (initiate Project Dashboard)

- • Project Dashboard (D6)

- o A managed, professionally curated Project Overview that is responsive to the wisdom of the collective (D5)
- o Stage and Work Tracking (D6)
- o Links to shared development documents with iteration tracking and document by document messaging tracking
- o Project communications (wiki-based discussion, instant messaging, video conferencing)

- ❑ Shared document repository

- ❑ Integrated Communication Systems

- o Out-going notifications to collaborators
- o Tracked wiki-based discussions (current and non-concurrent)
- o Instant messaging
- o Video conference for idea sessions, critiques, retrospectives and playbacks

- ❑ Integrated Funding Acquisition

- o Crowd-funding from individuals and institutions
- o Corporate Sponsorship

The proposed process overview for a Science Exhibition Collaborative web-based platform is illustrated in Fig 42.

Science Exhibition Collaborative Process / Model Overview
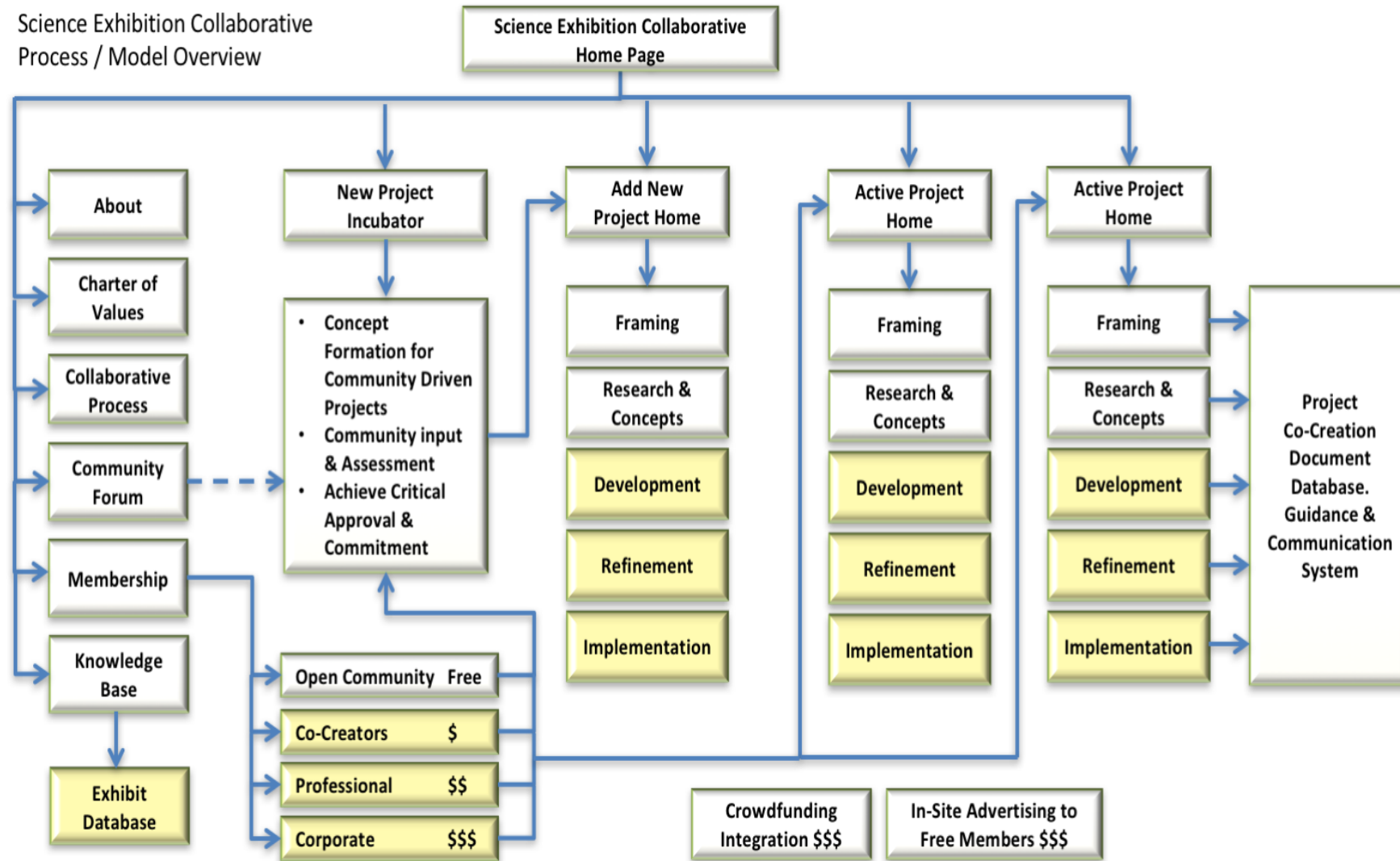
Figure 73 - Science Exhibition Collaborative web-based platform process and model overview

Figure 74 - Concept for "Science Exhibition Collaborative" home page with links to Top Projects New Projects Incubator, About, Our Collaborative Process, Charter of Values, Community Forum, Knowledge Base and Membership information.

Figure 75 - Concept for New Project Incubator page with integration of multiple on-line whiteboards with dedicated blogs.

VIRTUAL REALITY – PROJECT INCUBATOR

VR Learning Centre Experience Development

A collaborative space for posting, sharing, discussing and developing exhibition themes, concepts and content

" The best way to have good ideas is to have lots of ideas"
Linus Pauling

How to Use this Mural
Zoom In...Zoom Out...Explore Ideas
What's Missing?
Add your thoughts, topics, questions that should be asked...
...answer a question
...add a reference or URL
...put a star next to something you like

Quick Hints:
- "?" at top right for help
- select tools from bar on the left for text boxes, post-its & shapes
- use copy and paste commands, then double click to change text
- click, hold and drag to move something
- zoom using command & + or -
- navigate using the mini map at bottom right

Ettiquette
- add thoughts freely
- don't worry about messing things up
...that's part of the process
- there are no wrong contributions or bad ideas
- you can delete your bits, but generally leave what others add...but feel free to move it around and reorganize
- be polite
- its ok to point out concerns to consider...maybe use orange ------>

General Comments about this mural, process and your user experience.

Questions: tom.kasanda@osc.on.ca
416-676-0594

What do people need to know about VR/AR/MR?

What are the building blocks / concepts for learning / understanding VR/AR/MR?

Trending / Hot VR/AR/MR Topics

Miscellaneous Cool VR/AR/MR Things...(& links, images etc)

Cool Exhibition Titles

VR/AR/MR Exhibit Ideas

What are the elements needed for success?

Audience · Content · Design · Milestones · Value Proposition · Big Idea · Criteria & Constraints · Branding · Roles · Promotion · Venue · Funding · Partners / Sponsors

"Drivers" for informal science learning exhibits

PARKING LOT
Don't know where to put something...Put it here.

Is there a single term that encompasses VR/AR/MR?

CHAT FEED

To dolor sit amet, consectetuer adipiscing elit. Aenean commodo ligula eget dolor. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.

Aenean massa. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.

Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.

Integer tincidunt. Cras dapibus. Vivamus

Nulla consequat massa quis enim. Donec pede justo, fringilla vel, aliquet nec, vulputate eget, arcu. In enim justo, rhoncus ut, imperdiet a, venenatis vitae, justo.

. Integer tincidunt. Cras dapibus. Vivamus elementum semper nisi. Aenean vulputate eleifend tellus. Aenean leo ligula

TEAM MEMBERS

1. Lorem ipsum
2. Aenean commodo
3. Hooley Dilwad
4. Magnis dis parturient
5. Donec Quam
6. Quis Sem.
7.
8.
9.
10.

FAQ

1. You need 10 members to launch a Free Project

INVITE MEMBERS

2. Magnis dis parturient montes, nascetur ridiculus mus.

OPEN VIDEO STUDIO

3. Donec quam felis, ultricies nec, pellentesque eu, pretium quis, sem.

LAUNCH YOUR PROJECT

4. Nulla consequat massa quis enim. Donec pede justo, fringilla vel, aliquet nec, vulputate eget, arcu.

DOCUMENT LINKS

1. Lorem ipsum dolor sit amet, consectetuer adipiscing elit.
2. Aenean commodo ligula eget dolor.
3. Aenean massa. Cum sociis natoque penatibus.
4. Magnis dis parturient montes, nascetur ridiculus mus.
5. Donec quam felis, ultricies nec, pellentesque eu, pretium quis, sem.
6. Nulla consequat massa quis enim. Donec pede justo, fringilla vel, aliquet nec, vulputate eget, arcu.
7. In enim justo, rhoncus ut, imperdiet a, venenatis vitae, justo.
8. Lorem ipsum dolor sit amet, consectetuer adipiscing elit.
9. Aenean commodo ligula eget dolor.
10. Aenean massa. Cum sociis natoque penatibus.

CROWDFUND YOUR PROJECT

KNOWLEDGE BASE

EXHIBIT DATABASE

ADVERTISING

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Aenean commodo ligula eget dolor.

Aenean massa. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Donec quam felis, ultricies nec, pellentesque eu, pretium quis, sem. Nulla consequat massa quis enim. Donec pede justo, fringilla vel, aliquet nec, vulputate eget, arcu. In enim justo, rhoncus ut

Figure 76 - Concept shows zooming in to a Project Incubator. Features virtual whiteboard, integrated chat, member list, FAQ, document and other links. Illustrates advertising to "Free" members.

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Figure 77 - Concept for Process and Document Matrix. Green shading indicates completed documents. Allows for easy onboarding of new members who can review project documents and be guided to areas that require work.

Stakeholders

- **Materials Research Society**
- **Material Science Companies**
- **Ontario Science Centre**
- **NSF**
- **Education System**

T | M | C

Audience

- **High school students**
- **Families**

T | M | C

Project Vision, Mission & Goals

- Get people excited about materials
- Increase public awareness and understanding, public profile and public support for Material Science
- Reflect the goals of the MRS – layer textured richness
- MRS is the Mecedes Benze of Societies – the highest level of quality
- The focus of the society is cutting edge research
- Exhibits link with members, link research to person on the street
- Provide linkages for MRS members to NSF outreach goals

T | M | C

Engagement Model

Nam eget dui. Etiam rhoncus. Maecenas tempus, tellus eget condimentum rhoncus, sem quam semper libero, sit amet adipiscing sem neque sed ipsum. Nam quam nunc, blandit vel, luctus pulvinar, hendrerit id, lorem. Maecenas nec odio et ante tincidunt tempus. Donec vitae sapien ut libero venenatis faucibus. Nullam quis ante. Etiam sit amet orci eget eros faucibus tincidunt. Duis leo. Sed fringilla mauris sit amet nibh. Donec sodales sagittis magna. Sed consequat, leo eget bibendum sodales, augue velit cursus nunc,

T | M | C

Communication Goals

- **Materials are incredibly cool, materials are inherently fascinating**
- **Materials profoundly influence the quality of our everyday lives**
- **The structure of materials at the micro-scale defines the nature and behavior of materials at the macro-scale**

T | M | C

The Big Idea

The properties and performance of materials are shaped by their structure and processing.

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Key Concepts

- The term "materials" encompasses a broad spectrum of substances: polymers, ceramics, metals and composites
- Materials have properties, properties can be manipulated.
- Structure controls everything, structure occurs at different scales.
- Performance is properties over time (how materials perform over time and within environment)
- Materials are processed. Processing affects structure. Structure affects properties. Therefore processing affects performance
- Material properties > defects matter > size maters
- The rules change as scale changes
- It's the defects – defects affect properties, defects can enhance or detract from material properties, defects can strengthen materials
- Dislocations > affected by impurities

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Look & Feel

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Voice

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Concept Brief (1 pager)

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Figure 78 - Concept illustrates how interrelated documents can be automatically and intelligently organized and presented for work and review.

Exhibit Ideas

visual models of coding functions

program a robot to navigate a maze

Adjust the code on a Baxter the Robot and observe an outcome

coding in movies - fact of fiction

coding gone wrong

find the bug - debug a piece of code

falling ball through an and / or gate logic tree

walk-through maze with logic choices

Machine vision - how code allows machines to see?

historical foundations eg. Enigma, punch cards, looms

Blockly | Google Developers
Visual programming editor. Drag and drop blocks to generate executable code. Designed for developers to embed into websites or mobile apps.

zoom in on code -zoom in to different parts of a complex code to see its simple building blocks

look at code from some very common or iconic products - calculator, Pokemon ap, Photoshop, video game,

Match the code to the object it operates

adjust a series of blinking LEDs by selecting or moving different bits of code

From Screens to T and 0's. Deconstruct a smart phone from display screen down to the code by zooming into the different layers of components end operations until you reach the code at the level of electrons moving through solid state gates

AI TASK MANAGER / CHECKLIST
- ❑ Research / generate more exhibit idea.
- ❑ Keep in mind communication goals and key concepts
- ❑ On-line work sprint scheduled for Tuesday July 28 at 8pm. Use SCAMPER.
- ❑ Voting session at 10 pm then sort

Key Concepts
- The term "materials" encompasses a broad spectrum of substances: polymers, ceramics, metals and composites
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Communication Goals
- **Materials are incredibly cool, materials are inherently fascinating**
- **Materials profoundly influence the quality of our everyday lives**
- **The structure of materials at the micro-scale defines the nature and behavior of materials at the macro-scale**

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CHAT / IM

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Figure 79 - Concept for Team Brainstorming Sprint with Video Manger, selected documents and integrated chat and whiteboard.

Figure 80 - Concept showing how different document selection views can provide improved ability to quickly understand inter-relations between different project components. Here it is possible to check for the proper balance of messages using Word Maps.

Experience Idea
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Thumbnail

Communication Assessment
Structure
Performance
Processing
Properties
Influence lives
Cool Micro > Macro

Preliminary Content Report
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Draft Concept Spec
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Engineering Requirements
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Exhibit Rendering

Preliminary Experience Concept
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In-depth Content Research Report
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Final Concept Spec
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Graphic Design Layout
WHAT DO THE TWO DIFFERENT SIZES OF BALL BEARINGS REPRESENT?

Sketch

Prototype Report
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Design Intent Drawing

Fabrication Drawing

Exhibit / Experience

As-Built Drawing

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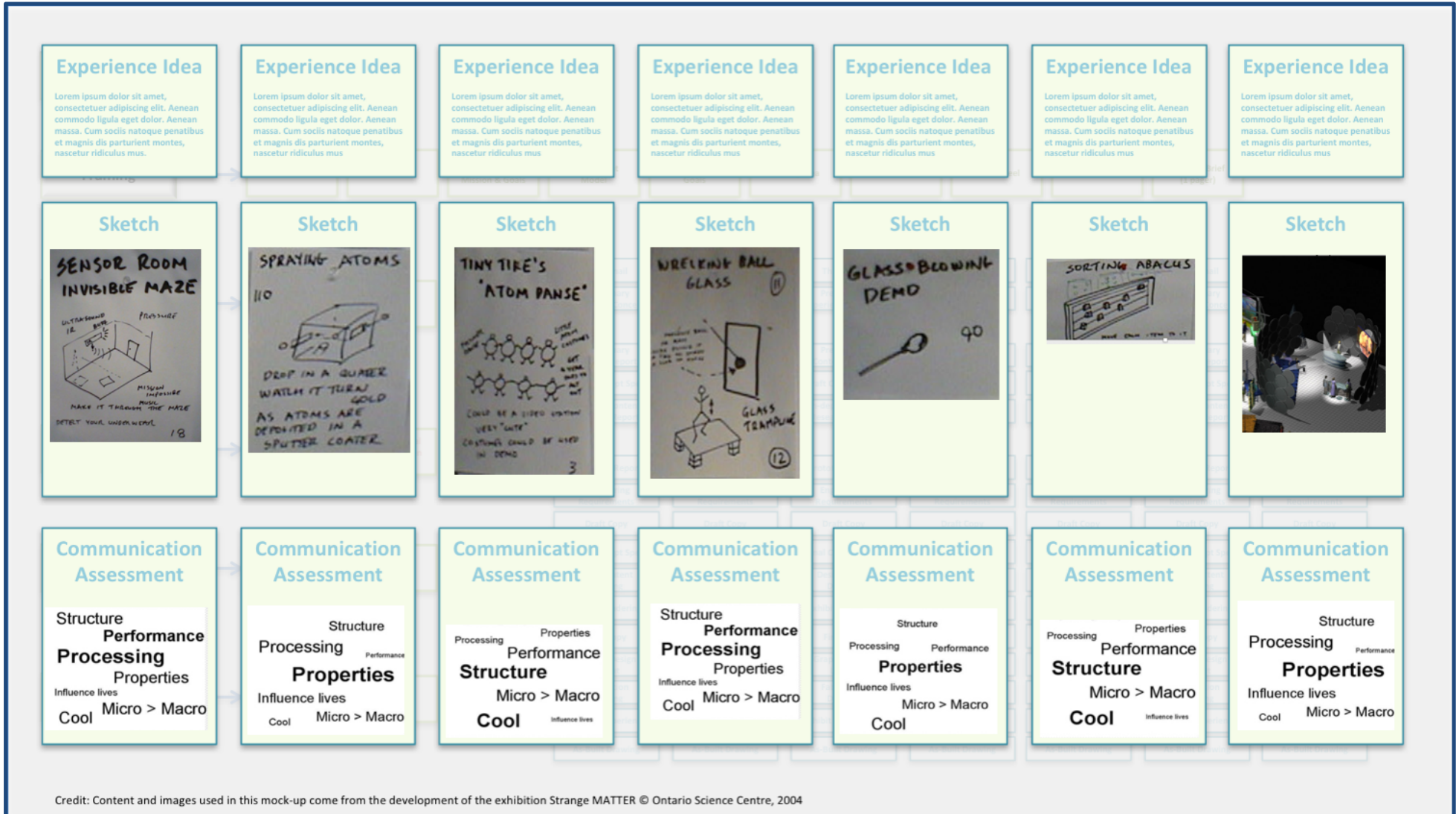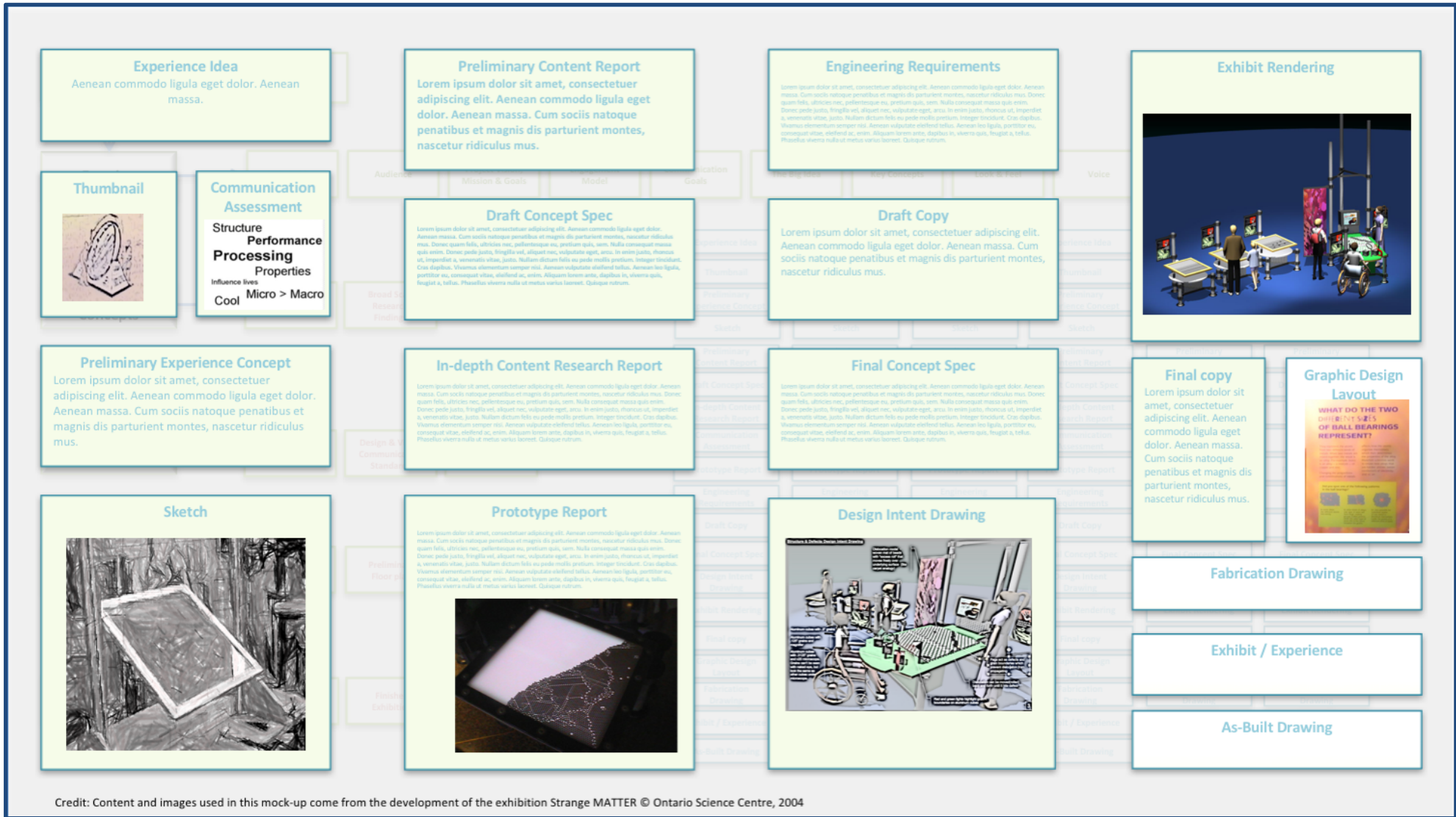
Figure 81 - Concept showing how different document selection views can provide improved ability to quickly understand inter-relations between different project components. Here it is possible to view the progress of a single exhibit and identify the next component to work on.

Figure 82 - Concept illustrating how the AI Task Manger can present a set of shared documents and chat instructions for changes required to the graphic panel for an exhibit in progress.