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Collaborative DeSIGn
Mapping success in collaborative engineering

Workshop Report

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Workshop Summary

The purpose of the Collaborative DeSIGn workshop was to explore the possibility of using a causal loop diagram to reflect a mapping between the key factors that influence the success or failure of collaborative design. The workshop initially focused on identifying the key factors and using this as a basis to create cause/effect (Ishikawa) diagrams. The key factors that were identified by the groups to influence collaborative design success/failure were: human interaction; goals; collaboration tools and techniques; motivation; efficiency; planning; governance; team; social; organization; people/individuals; and collaborative processes.
The workshop was organized by the University of Strathclyde. The workshop chairs would like to thank the organisers of the DESIGN conference for allowing the workshop to take place.

1. Workshop Overview

1.1 Background and Objectives

Successful collaborative engineering practices have demonstrated significant benefits to industry: improving efficiency; eliminating rework due to information inconsistencies; managing complexity and automating parts of the collaborative design process. Despite these benefits, collaborative endeavours fail due to obstacles such as: sharing knowledge through ineffective communication methods; co-ordinating stakeholders with divergent objectives; managing teams with cultural and leadership differences; and configuring collaborative networks towards a long term and strategic vision. Changing innovation landscapes have the potential to radically advance collaborative practices to develop more user-centred, innovative and customised products in a timelier manner.
The Collaborative Design SIG have been working to define the characteristics of successful collaborative practices through previous workshops exploring the changing innovation landscape. These characteristics present complex challenges to conventional industrial practice and confounds the benefits gained from wide-spread implementation. These challenges could for example relate to the complexities of extending knowledge management practices beyond the boundaries of the organisation and the subsequent manipulation of this knowledge; the operation of formal and informal collaborative networks that manages ambiguity, equivocality, and conflicting constraints; the adaptation of organisational structures to become more flexible, agile and open; and the ownership of the product development process.

1.2 Workshop Structure & Materials

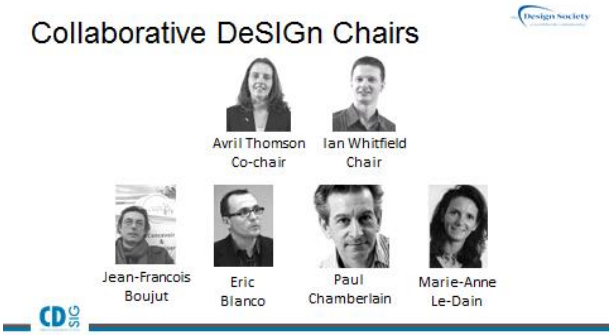
The workshop brought together collaborative design and innovation researchers with the aim of creating a coherent, integrated, and more holistic understanding and definition of the factors that contribute to collaborative design success and failure. The workshop consisted of researchers from industry and academia to facilitate networking and knowledge exchange benefiting all participants. A design-centred approach was used within the workshop to address the following questions:

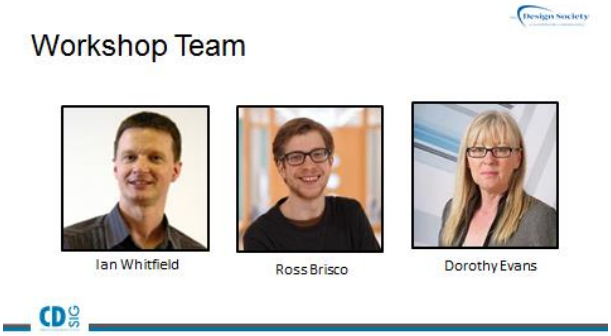
- What are the factors that contribute towards and constrain successful collaborative engineering?
- Can the factors be modelled in relation to each other towards a definition of successful collaborative engineering?
- What are the future collaborative engineering challenges to meet the changing innovation landscape?

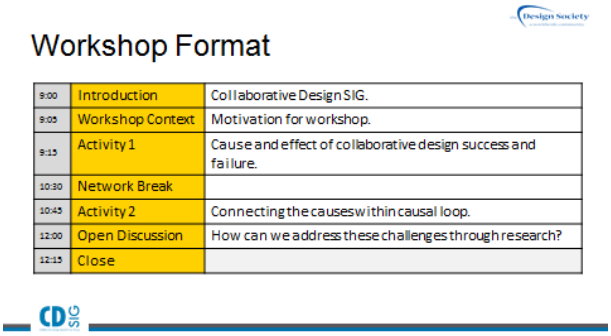
The Workshop was formatted as follows:

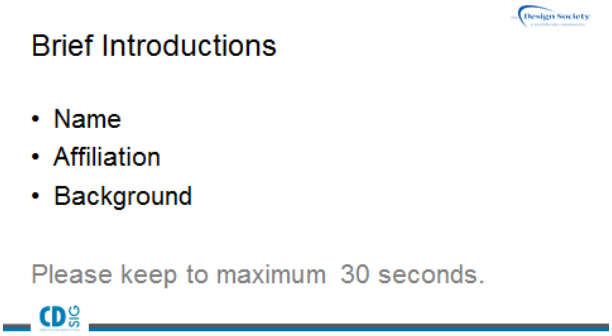
- Participants were introduced to the motivation for the workshop and then engaged in a discussion on the benefits and challenges of successful collaborative engineering.
- Activity 1 introduced cause and effect diagrams using an example from a design rework perspective. Three groups were subsequently formed to define and model the key elements of successful collaborative engineering and how key factors influence the success or failure of collaborative design. The results of each group were presented within the workshop.
- Activity 2 was intended to take the key factors and use them to create causal loop diagrams. This activity was not completed due to time constraints. However causal loop diagrams for collaborative design previously prepared by Ross Brisco were presented to promote the discussion relating to future research activity. It is anticipated that the next Collaborative DeSIGn workshop could take these results and build on them further.

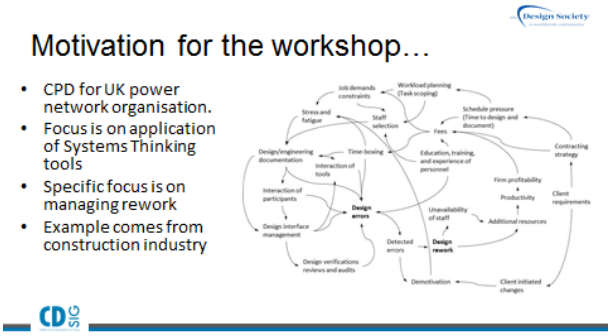
The following slides were used within the workshop:











Motivation for the workshop…

Successful collaborative design is characterised by:

- Enhanced creativity and innovation,
- Improved efficiency and effectiveness,
- Reduction in volume of rework,
- Management of complexity.

Unsuccessful collaborative design is characterised by:

- Lack of commitment,
- Lack of awareness of common and individual goals,
- Focus on short term rather than long term,
- Lack of appropriate reward.

Wider benefits of collaborative engineering?

- Rapid creation and articulation of viewpoints,
- Faster construction of networks,
- Democratisation of the product or service development process,
- Discontinuous and open innovation
- Adoption of dynamic capabilities to sustain competitive advantage.

Activity 1

What are the causes for collaborative design success and failure?

Using cause and effect diagrams

Identify the problem:

What major factors contribute towards success within collaborative design endeavours?

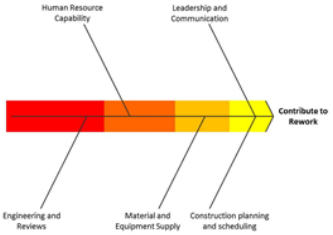
And/or:

What major factors contribute towards failure within collaborative design endeavours?

Using cause and effect diagrams

Identify the major factors involved – may be systems, processes, people, external considerations

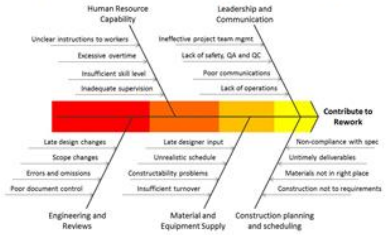
Rework cause and effect example



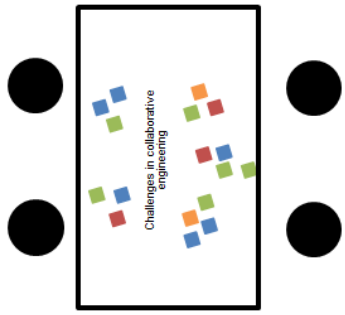
Using cause and effect diagrams

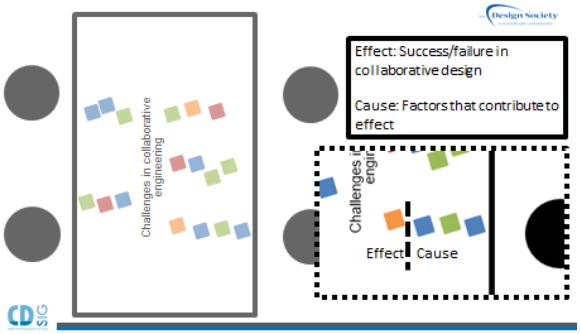
Identify possible causes for each of the major factors

Rework cause and effect example



Activity 1





Activity 1

What factors contribute towards collaborative design success/failure?

1. Consider factors individually – 15 minutes.
2. Discuss in your group(s) – 20 minutes.
3. Draw Ishikawa skeleton.
4. Agree on major factors – 10 minutes.
5. Post-it your causes onto major factors – 20 minutes.
6. Share with the group – 10 minutes.

Break – 10:30 for coffee

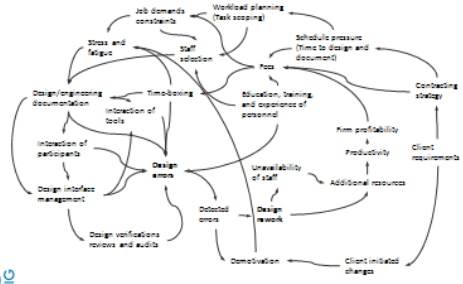
Activity 2

How are the factors the influence collaborative design linked together?

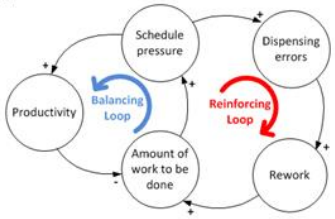
Connecting causes together

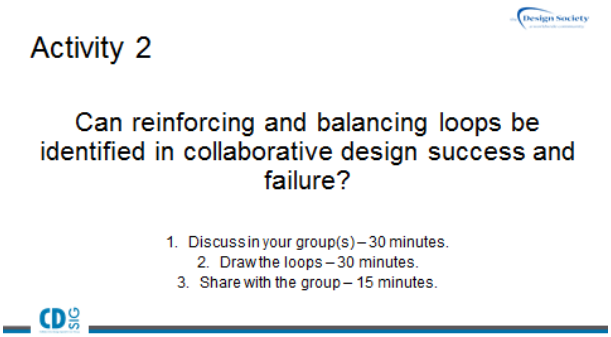
- Ishikawa diagram provides a useful start to understand how causes influence each other.

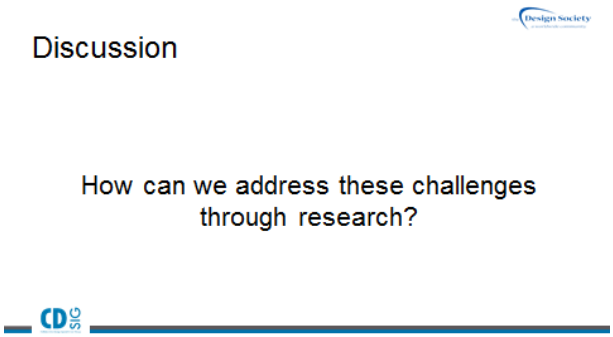
Rework causal loop diagram

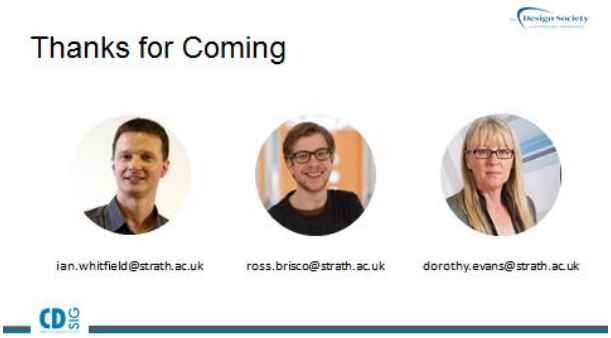


Activity 2





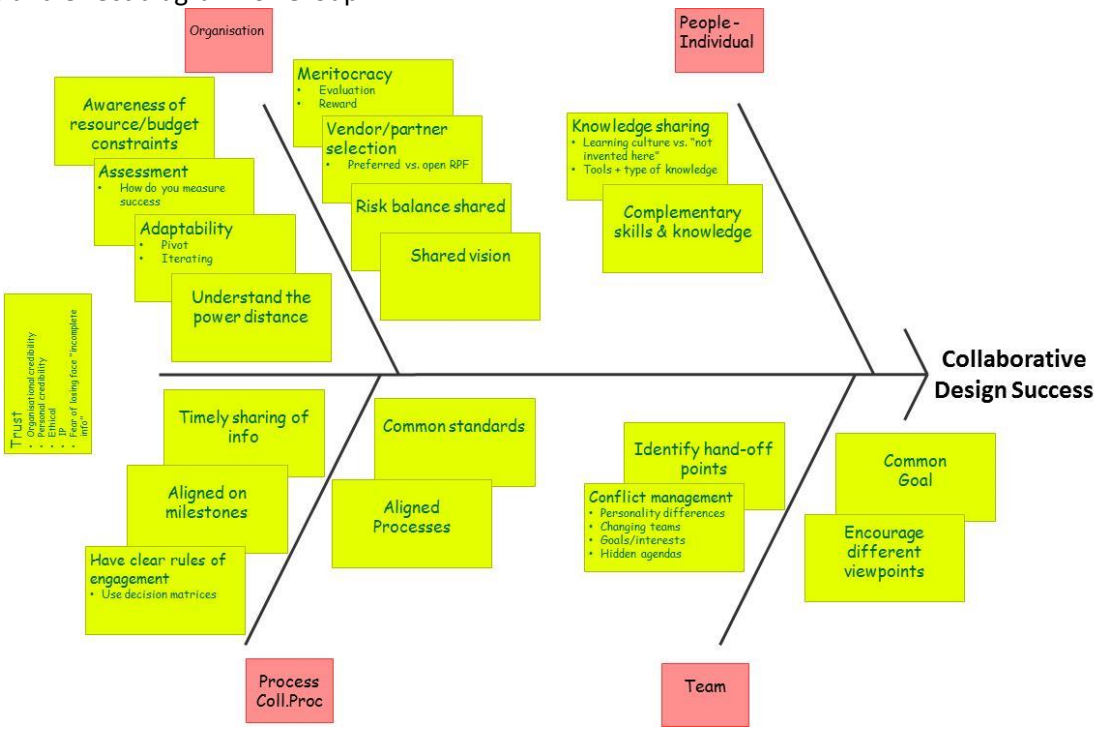




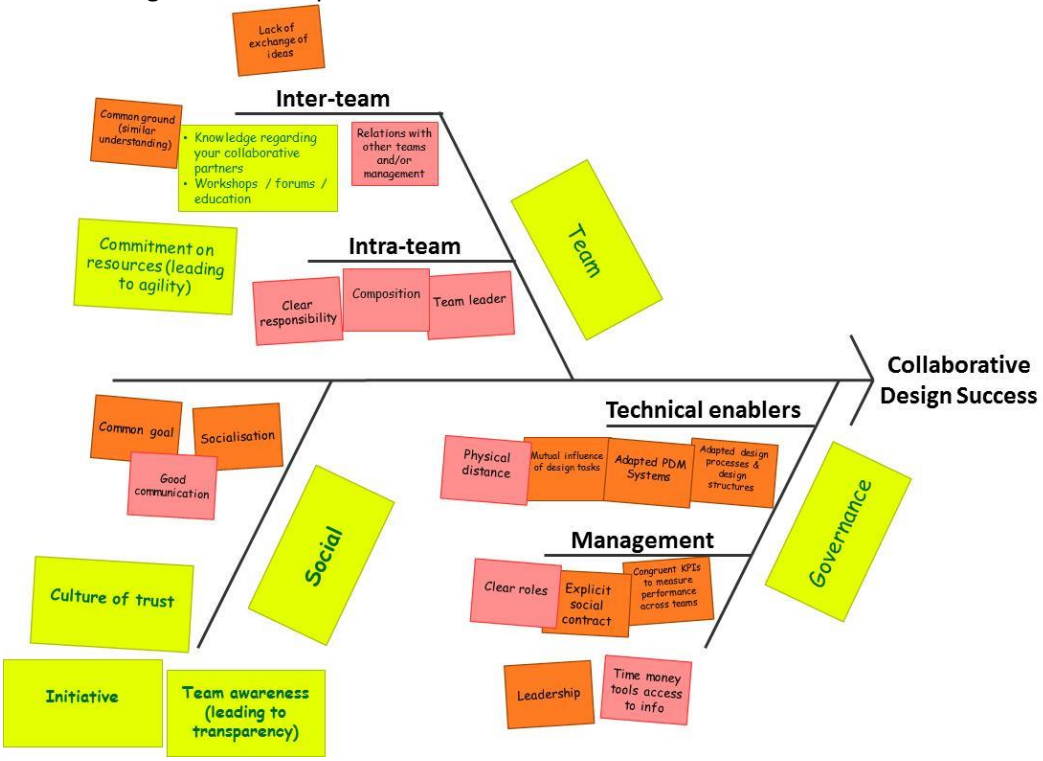
2. Workshop Discussions

The outcome of Activity 1 was encapsulated within three cause/effect diagrams – one for each of the groups. The choice of whether they focus on success or failure was left to each group to decide.

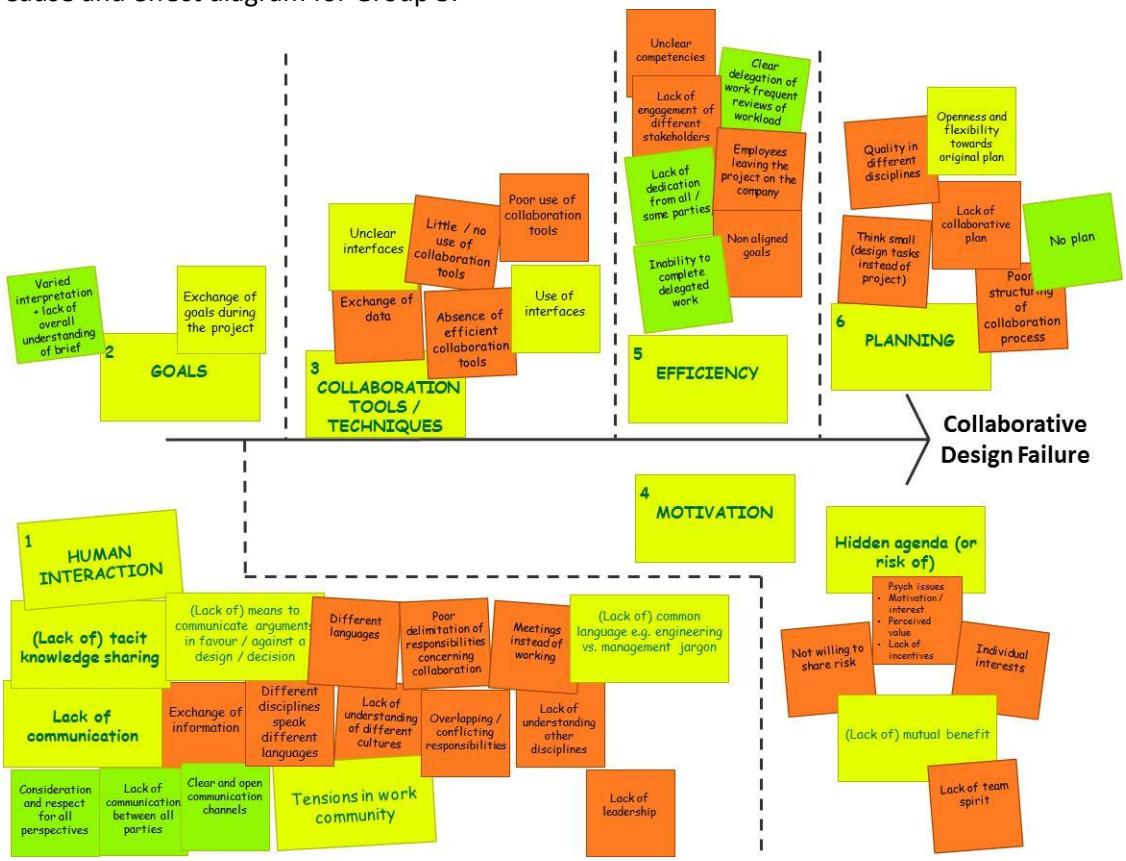
Cause and effect diagram for Group 1:



Cause and effect diagram for Group 2:



Cause and effect diagram for Group 3:



The workshop subsequently focused on the causal loop diagrams produced by Ross Brisco as a focal point of the second part of the workshop. The differences between cooperative design and collaborative design were discussed with the sharing of risk being highlighted as the distinguishing feature between the two. An insightful discussion followed relating to relationship between complexity management within product development and collaborative design.

3. Next Steps and follow up

This report will be distributed to the attendees of the workshop and an invite included to continue with the development of a causal loop for collaborative design.

4. Lessons Learned, and Conclusion

4.2 Lessons Learned

The key factors identified within the cause/effect diagrams highlights the breadth of scope for understanding and modelling collaborative design success and failure. It highlights that it incorporates a significant focus on human factors and interaction from social and trust perspectives; requires

appropriate consideration of the organizational structure, processes and governance; and is influenced by the construction and operation of teams.

4.3 Conclusion

The workshop was well attended, with lively, relevant and thought provoking discussion and debate both within the groups (when focused around the cause/effect diagrams) and within the workshop as a whole. The group understood the nature of the activity, and demonstrated that it is possible to use systems thinking tools in order to model collaborative design. The first step was taken in this respect by generating three cause/effect diagrams that reflect the key factors that influence collaborative design success and failure. The next stage is to consolidate this output and establish the approach towards creating a causal loop diagram.

Appendix A: Participant List

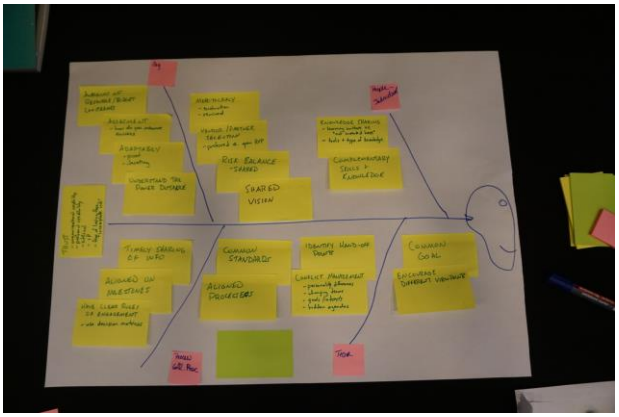
Sara Nilsson – Saab
Petr Witz – Technical University of Denmark
T.F.Beernaert – Eindhoven University of Technology
Jasmin Juranić – Daimler AG
Raphael Marin - University of São Paulo
Letizia Cardelli – Main Engineering
Asko Ellman – Tampere University of Technology
Eugen Rigger – V Research
Ivan Esparragoza – PennState Brandywine
Marco Bertoni – Blekinge Institute of Technology
Hannah Forbes – University of Liverpool
Benjamin Poulain –
Stacy Benjamin – Northwestern University
Angela Maddox – Microsoft
Marcus Pereira Pessoa – University of Twente
Julian Schönwald - Universität der Bundeswehr München
Christian Marxt – ETH Zurich

Ross Brisco – University of Strathclyde
Dorothy Brisco – University of Strathclyde
Ian Whitfield – University of Strathclyde

Appendix B: Workshop photographs



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