EPSRC Centre for
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Technical Seminar Series

Ubiquitous Sustainability: Embedding Sustainability Throughout Product Design Processes

Leila Sheldrick

LOUGHBOROUGH UNIVERSITY

15:00-16:00 17 November 2015

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Technical webinar series – schedule

17 NOVEMBER 2015

- **Today:** We will explore the strategic improvement of sustainable design practice, and learn about how a company can tailor their approach towards embedding sustainability within established processes.
- **Next:** 16.00 3rd December "Eco-Intelligent process monitoring", Loughborough University
- Future months: much more to follow!!
- … and it could be you…
- Typically first Thursday of the month

We will record this webinar and issue the recording afterwards

Slides will also be made available

Please use chat to raise questions throughout the presentations

Questions after this presentation finishes? Please contact:

Leila Sheldrick

l.sheldrick@lboro.ac.uk

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Technical webinar series – the aims

8 OCTOBER 2015

EPSRC Centre for INDUSTRIAL SUSTAINABILITY

- Sharing **research** results and **industrial** practice for Centre members
- **Connecting people** within the Centre as well as outside the Centre
- Providing **feedback**, comments, suggestions, refinement, etc to those presenting

If you have interesting content to share from research and development, good practice, valuable results in practice, etc then perhaps you should be scheduled in the series?

*Contact **Sharon Mey** cis-admin@ eng.cam.ac.uk*

*or **Peter Ball**, p.d.ball@cranfield.ac.uk*

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How is the Centre structured?

Eco-efficiency

Reducing resourse use (water, energy, materials)

Improvements without radical changes to product or process

Eco-factory

Increasing added value and improving production capability and responsiveness

Decreasing consumption of natural resources

Sustainable Industrial System

Exploring future configurations of the industrial system and their implications

Taking first steps to improve understanding of the long term challenges facing industry

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How the Centre works - Impact

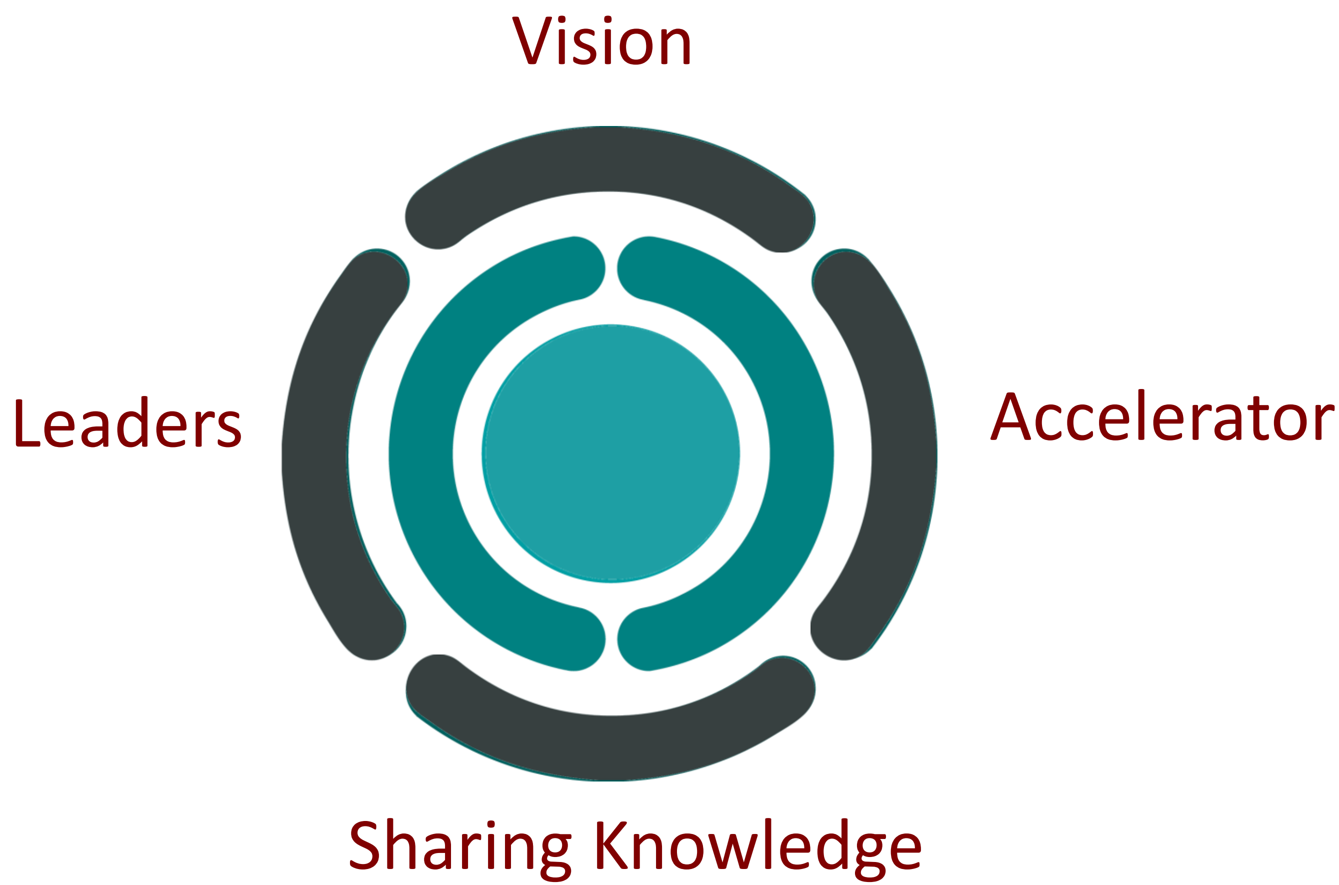
WEBINARS … CONTRIBUTING TO SHARING OUR KNOWLEDGE

Educating the **Leaders** of Tomorrow **TODAY**

Bigger **Impact**, faster, wider, sooner

Sharing **Knowledge**

Building & Sharing a **Vision**



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Eco-Factory Grand Challenge: Improving Design Practice for Manufacturers

17 NOVEMBER 2015

15.00 **Introduction** (Peter)

15.10 **Ubiquitous Sustainability: Embedding Sustainability Throughout Product Design Processes** (Leila)

15.30 **Q&A** (Leila)

15.40 **Wrap up** (Peter)

15.45 Close

Questions after this presentation finishes? Please contact

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Ubiquitous Sustainability: Embedding Sustainability Throughout Product Design Processes

Leila Sheldrick

Lecturer in Product Design Engineering

LOUGHBOROUGH UNIVERSITY (until January 2016)
IMPERIAL COLLEGE (from February 2016 onwards)

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Ubiquitous Sustainability

EMBEDDING SUSTAINABILITY THROUGHOUT DESIGN PROCESSES

1. Project Background
2. Improving Sustainable Design
3. The D*f*US (Design for Ubiquitous Sustainability) Framework

The Importance of Design Improvements

EARLY INTERVENTION GIVES THE GREATEST ENVIRONMENTAL REWARDS

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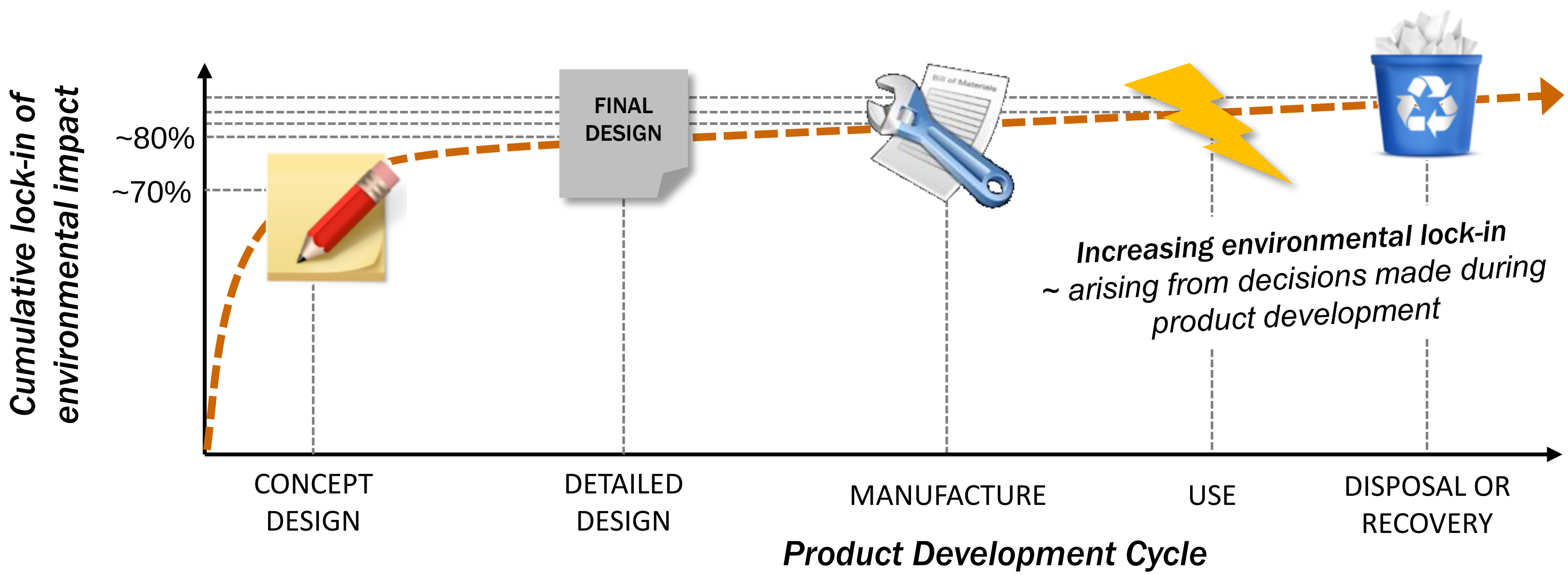
- The majority of the environmental impact of a product is decided during the design phase, with most decided after only 20% of the design activity has been undertaken!



Adapted from: **Lewis, H., Gertsakis, J., Grant, T., Morelli, N., Sweatman, A. (2001);** Design + Environment: A Global Guide to Designing Greener Goods.

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The Big Questions Asked During This Research

WHAT PROBLEMS ARE WE TRYING TO HELP COMPANIES SOLVE?

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If sustainable design has so much potential, why aren't more companies doing it?

We set out to explore:

- How can sustainable design be better facilitated?
- How can we fit it into existing design processes?
- How will this design evolution occur?

ubiquitous:
adjective
Present, appearing, or found everywhere.

How can we make sustainability a ubiquitous part of product development?

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Why are Design Changes so Critical?

INCENTIVES AND DRIVERS FOR SUSTAINABLE DESIGN

- They help move beyond incremental changes in efficiency – ***towards racial, system level improvements.***
- They are a catalyst for raising awareness of sustainability challenges across the business.
- They increase competitiveness in the face of changing markets, and improve customer perception, leading to stronger links with all stakeholders.
- They help companies get ahead of new regulations and legislations.

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Success and Failure in Sustainable Design

CRITICAL FACTORS INFLUENCING ADOPTION OF SUSTAINABILITY

- Many sustainable design tools and approaches exist, but have varying success in application:

STUMBLING BLOCKS

- Awareness of sustainability issues within companies is often limited!
- Organisational complexities, and challenges with internal communication and cooperation.
- Regulations restricting innovation and driving reactionary solutions.

SUCCESS FACTORS

- Well established and controlled design processes, and capable designers!
- When the project supports wider business requirements, and is driven by legislation or customer demand.
- When sustainable design tools and methods are customised to the specific needs of the company.

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Considered Improvement of Sustainable Design

MAXIMISING THE POTENTIAL OF DESIGN IMPROVEMENTS

DESIGN PROCESS

- The improvement of the design process so that SD is not an afterthought, but is incorporated centrally throughout the design process from its outset.

IMPLEMENTATION METHODS

- The improvement of SD implementation methods within a company's product development process, particularly in the case of complex organisations and products.

HOLISTIC APPROACH

- The linking of SD practices with other relevant activities within a manufacturing company, such as process and plant design.

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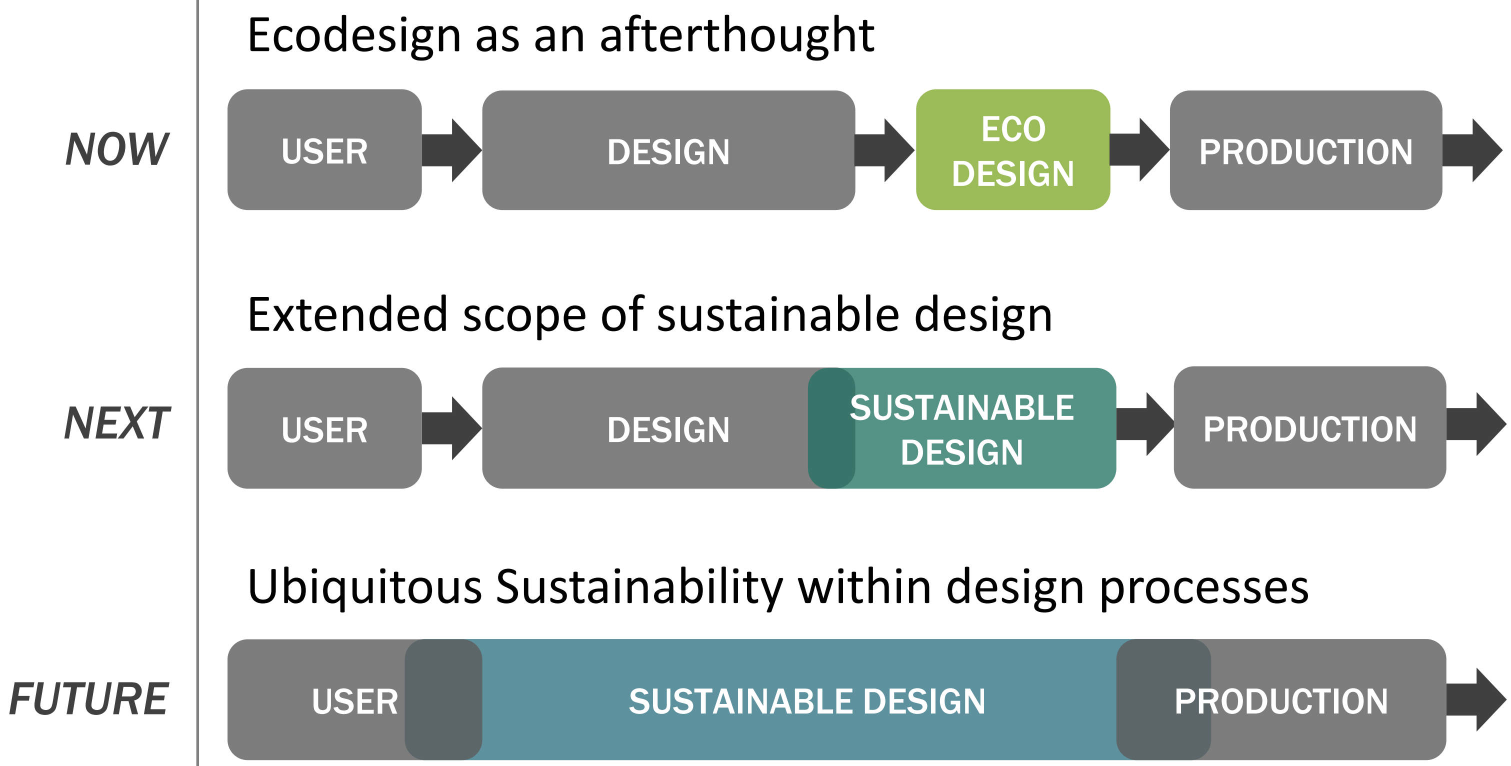
A Strategic Evolution of the Design Process

EMBEDDING SUSTAINABILITY INTO ESTABLISHED DESIGN PROCESSES



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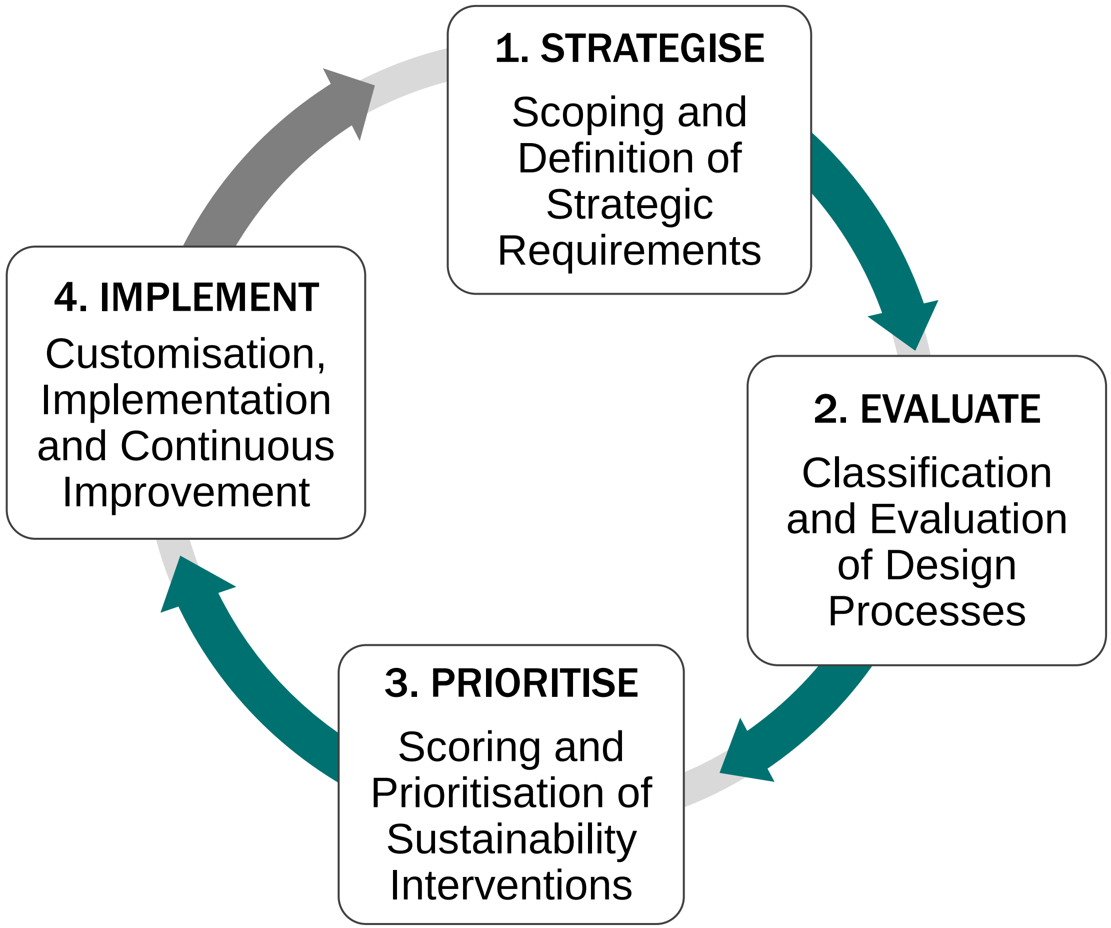
The D*f*US Framework

'DESIGN FOR UBIQUITOUS SUSTAINABILITY'

A systematic four step process for designing sustainability into your design processes.

Modelled on similar continuous improvements methods such as ISO 14001 and Life Cycle Assessment.



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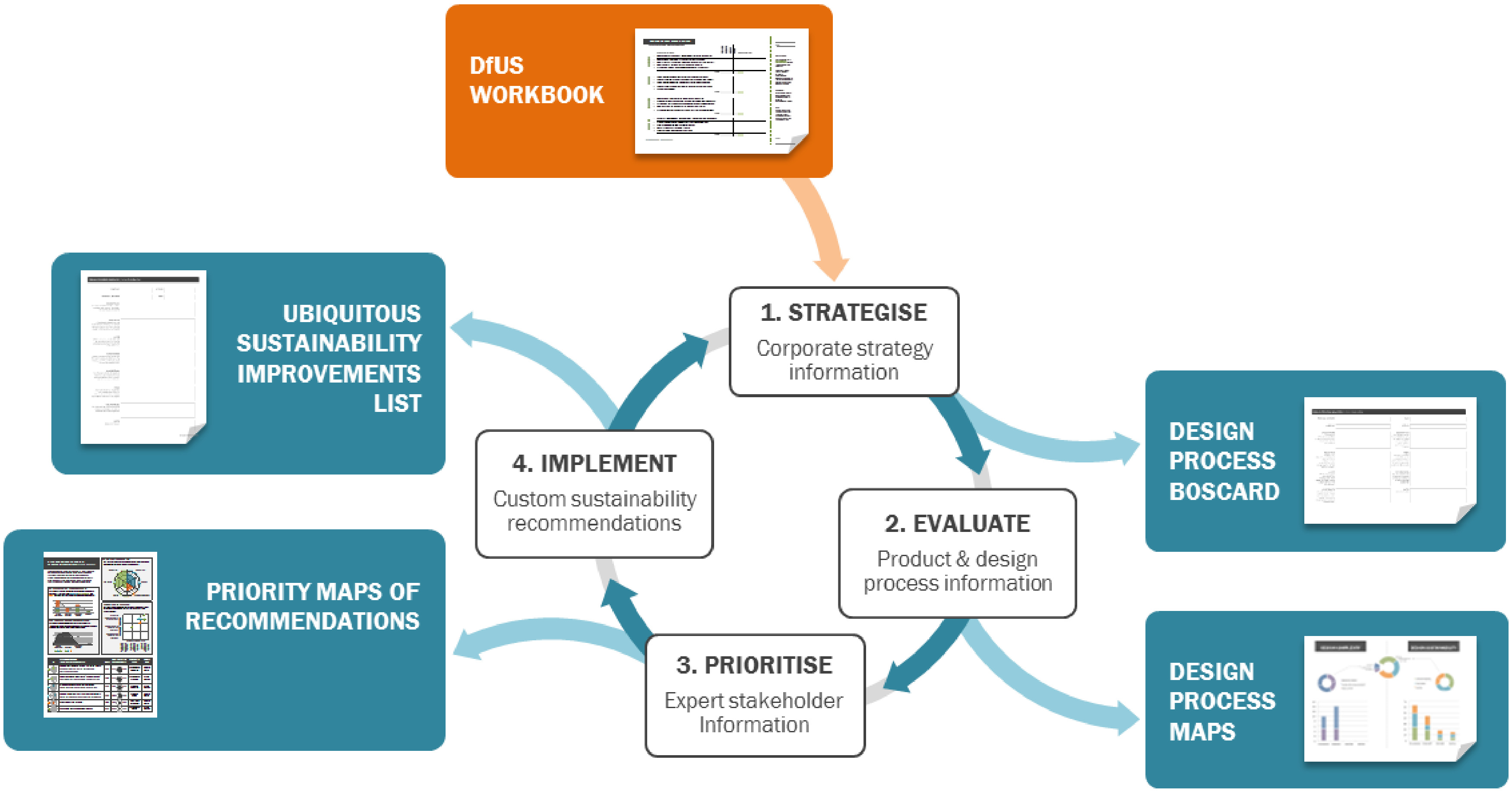
DfUS for Tailored Improvement Projects

STRATEGICALLY DESIGNING SUSTAINABILITY INTO DESIGN PROCESSES



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Phase 1. Strategise

SETTING THE SCOPE AND STRATEGY FOR THE IMPROVEMENT PROJECT

- The strategic requirements for the project are defined from the outset, to ensure the improvements targeted are purposeful and aligned with company needs.
- The D*f*US BOSCARD is used to help collect information about the improvement project:
  - Background
  - Objectives
  - Scope
  - Constraints
  - Assumptions
  - Risks
  - Deliverables

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D*f*US BOSCARD

SETTING DIRECTION FOR DESIGN PROCESS IMPROVEMENT

DESIGN PROCESS BOSCARD / D*f*US FRAMEWORK

PRODUCT/DIVISION		**DATE**	
COMPANY		**AUTHOR**	
BACKGROUND (Background information, e.g. type, purpose and reasons for project, and any key stakeholders)		**ASSUMPTIONS** (Any factors that are, for planning purposes, considered to be true e.g. assumptions about product, processes, data or impacts)	
OBJECTIVES (Project goals, objectives, and expected outcomes e.g. to improve market resilience, decrease energy usage or comply with an eco-label)		**RISKS** (Any risks identified including a quick assessment of how to address them e.g. time or money expenditure involved in the project)	
SCOPE (Which processes or products will be included, and which design activities / teams / departments will be included etc.)		**DELIVERABLES** (Key deliverables that the project is required to produce in order to achieve the stated objectives)	
CONSTRAINTS (Specific constraints or restrictions that limit or place conditions on the project, e.g. limits of project scope or areas of consideration)		**NOTES** (Extra information)	

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Phase 2. Evaluate

INVESTIGATING AND MODELLING THE DESIGN PROCESS

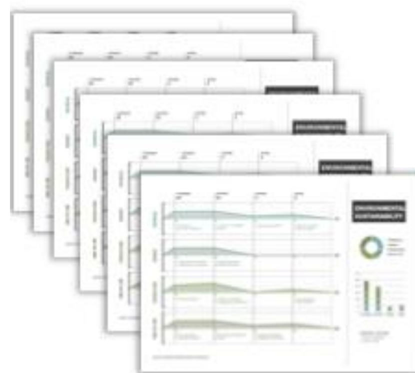
- The design process is evaluated and characterised to understand the key features that exist, and what needs to be improved.

D*f*US tables are used by the company to collect data about the design process.

This data is then compiled, and visualised in maps to show opportunities and targets for the inclusion of sustainability in the design process.

D*f*US TABLES

SUMMARY GRAPHS



DESIGN PROCESS MAPS

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DfUS Evaluation Tables

AIDING AND DIRECTING DESIGN PROCESS INVESTIGATION

ENVIRONMENTAL SUSTAINABILITY

/ CENTRAL DESIGN CENTRAL CONTROL

Product/Division:

Date:

		EVALUATION CRITERIA	PLANNING	CONCEPT	SYSTEM	DETAIL	SPECIFY DECISION
MATERIALS	i	Selection of recyclable materials (homogeneous, recyclable, limited variety)					
	ii	Selection of low impact materials (non toxic, responsibly sourced)					
	iii	Material separability (uncoated, limited use of adhesives, dissimilar densities)					
	iv	Material longevity (corrosion resistant, appropriate to use life)					
	v	Efficient use of material (optimised component design, light weighting)					
		TOTALS					
ENERGY	i	Energy type and source during use (from safe and renewable sources)					
	ii	Energy efficiency during use (efficient mechanisms and operation of product)					
	iii	Energy type and source used in production (safe and renewable sources)					
	iv	Energy efficiency in production processes (efficient machinery and systems)					
	v	Transportation methods					
		TOTALS					
PRODUCTION	i	Selection of low impact processes (energy efficient, zero waste)					
	ii	Economies of scale and standardisation (use of off-the-shelf and standard parts)					
	iii	Part geometry (design for manufacture, near net shape, minimised operations)					
	iv	Geographical location of manufacturing, operations and suppliers					
	v	Efficient packaging (minimised packaging materials and volume of packages)					
		TOTALS					
END OF LIFE	i	Upgradability and modularity (remanufacturing, maintenance, fewer components)					
	ii	Assembly methods (non permanent, accessible, standard head types)					
	iii	Labelling and Identification of parts to aid recycling					
	iv	Reliability and durability (extended life cycle)					
	v	Take back and collection methods and systems					
		TOTALS					

DIRECTIONS

This table highlights **environmental considerations** related to your product and company.

For each criterion, specify the most influential corresponding decision, and indicate the stage in the design process at which this decision is made.

SCORING

Give a score to each identified decision based on its overall **effect on environmental impact.**

KEY

0 = Not Applicable
1 = Negligible Effect
2 = Minor Effect
3 = Moderate Effect
4 = Significant Effect
5 = Severe Effect

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DfUS Evaluation Factors

TARGETING THE TABLES TO PROMOTE UNDERSTANDING

SUSTAINABILITY TABLES

Identify **TARGETS** for consideration of the key sustainability factors relevant for the business

↓

Environmental Sustainability

↓

Economic Sustainability

↓

Social Sustainability

COMPLEXITY TABLES

Identify **OPPORTUNITIES** for readily embedding sustainability considerations within established design process

↓

Product Design Complexity

↓

Knowledge Management Complexity

↓

Regulatory Complexity

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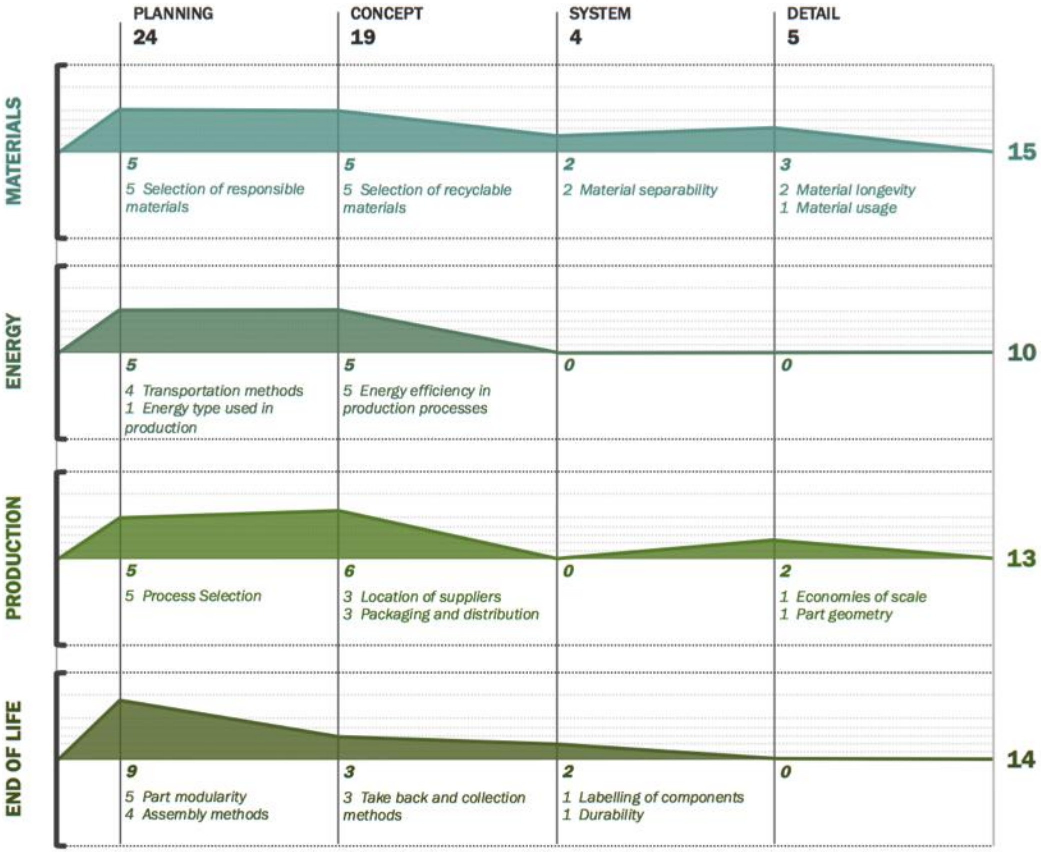
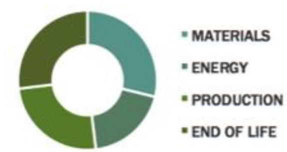
DfUS Summary Graphs

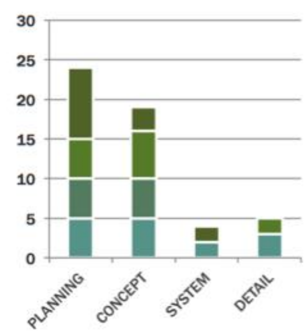
DIRECT MAPPING AND VISUALISATION OF THE TABLES



DfUS SUMMARY GRAPH

ENVIRONMENTAL SUSTAINABILITY





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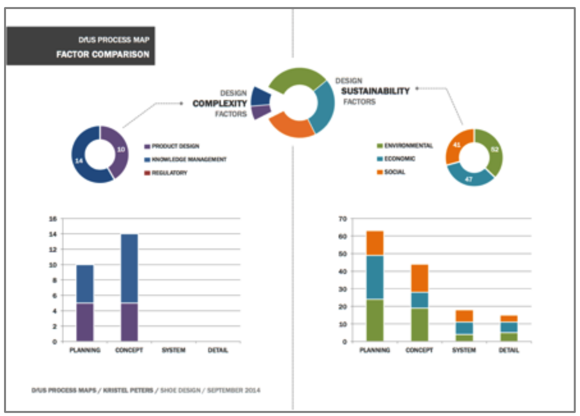
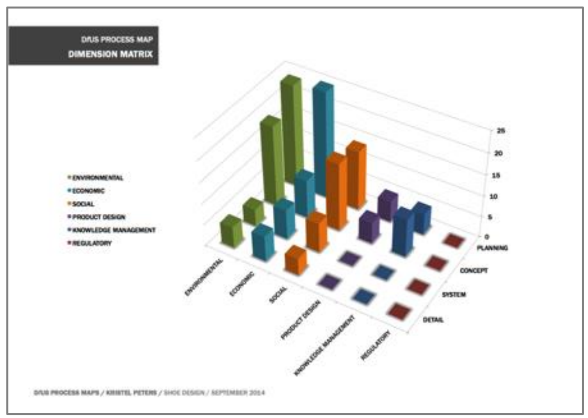
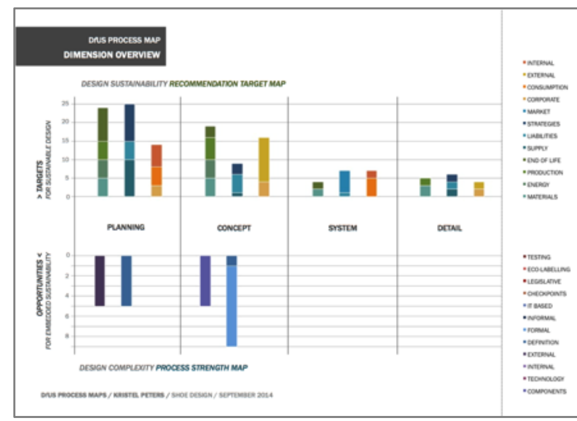
DfUS Design Process Maps

SUMMARY MAPS VISUALISING THE WHOLE DESIGN CHAIN

- These maps give a high level overview of the identified strengths and weaknesses across the existing design process.
- They therefore enable patterns to be seen more easily, and opportunities for improvement to be readily identified.

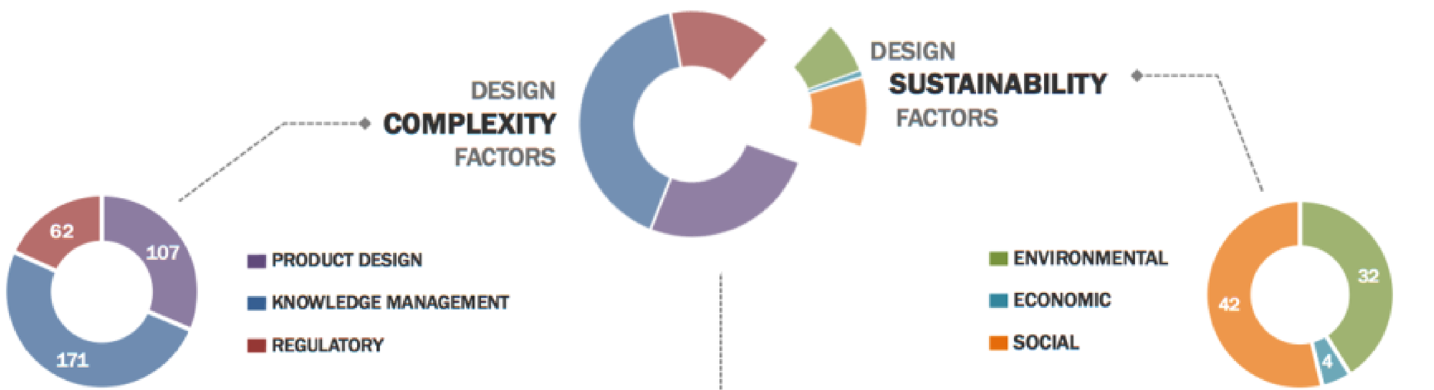


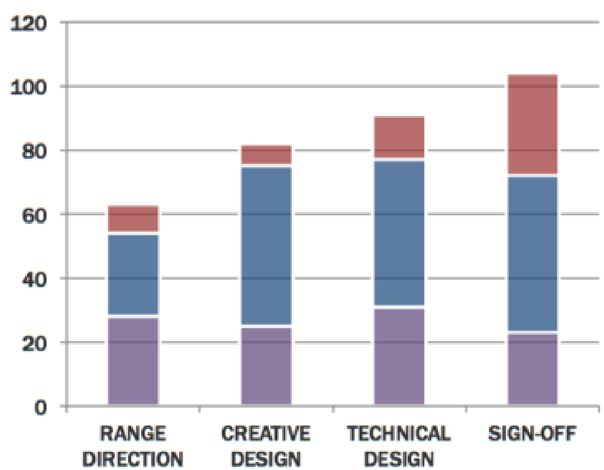


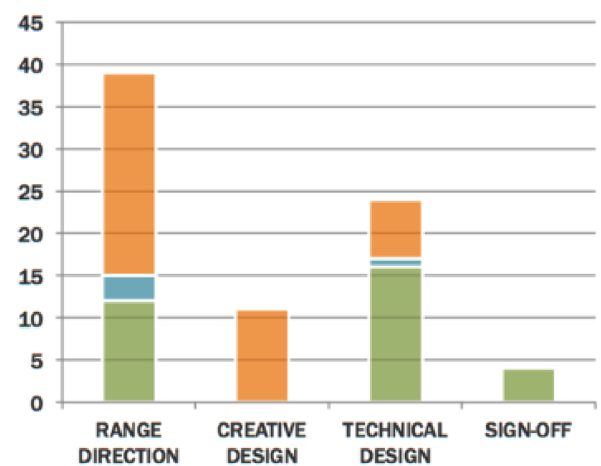


Visualising the Design Process using D*f*US Maps

FACTOR COMPARISON EXAMPLE







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Phase 3. Prioritise

SELECTING THE MOST BENEFICIAL AND FEASIBLE IMPROVEMENTS

- Targeted recommendations for sustainable design improvement are identified using the maps of the design process produced.
- Experts across the company score these recommended improvements based on four **assessment factors**, to give a final ranked list of suggestions.

Overall Feasibility

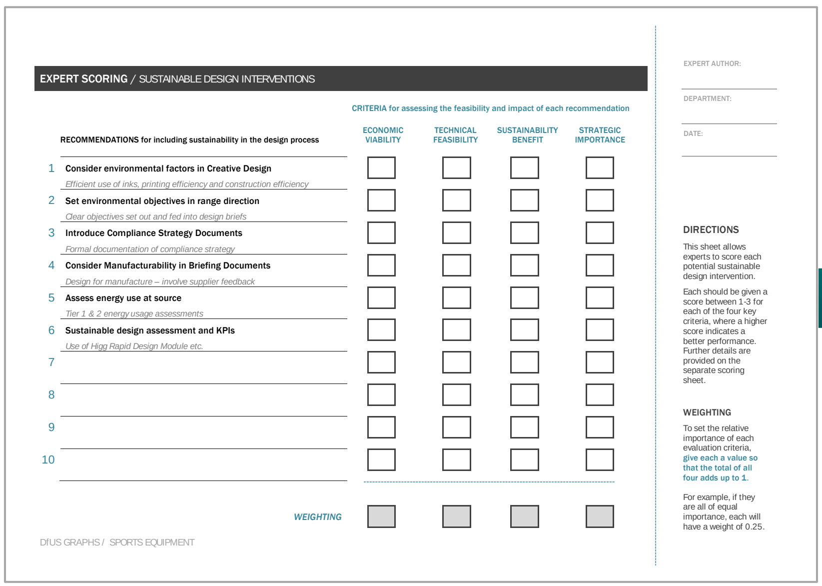
- Economic Viability
- Technological Feasibility

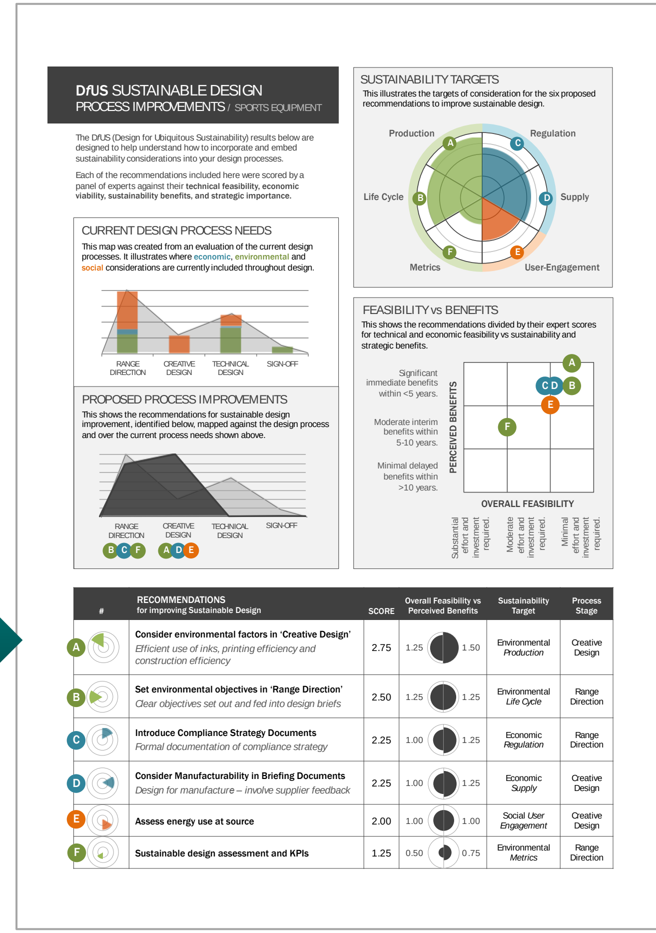
Perceived Benefits

- Sustainability Benefits
- Strategic Importance

Ranking the Improvement Recommendations

- Recommendations for improvement are put into a form to be ranked by experts, and the findings are calculated and summarised in a final report form.





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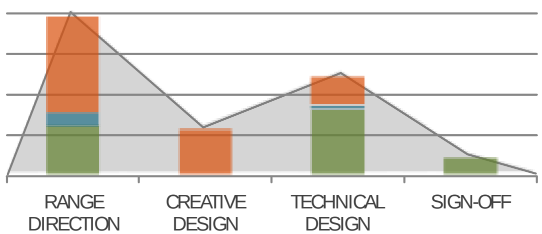
Prioritised Process Improvement Mapping

EXCERPTS FROM THE FINAL D*f*US REPORT FORM

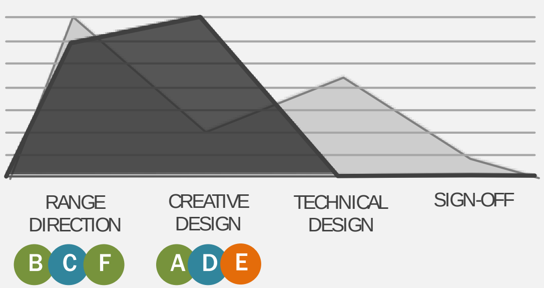
CURRENT DESIGN PROCESS NEEDS

This map was created from an evaluation of the current design processes. It illustrates where economic, environmental and social considerations are currently included throughout design.



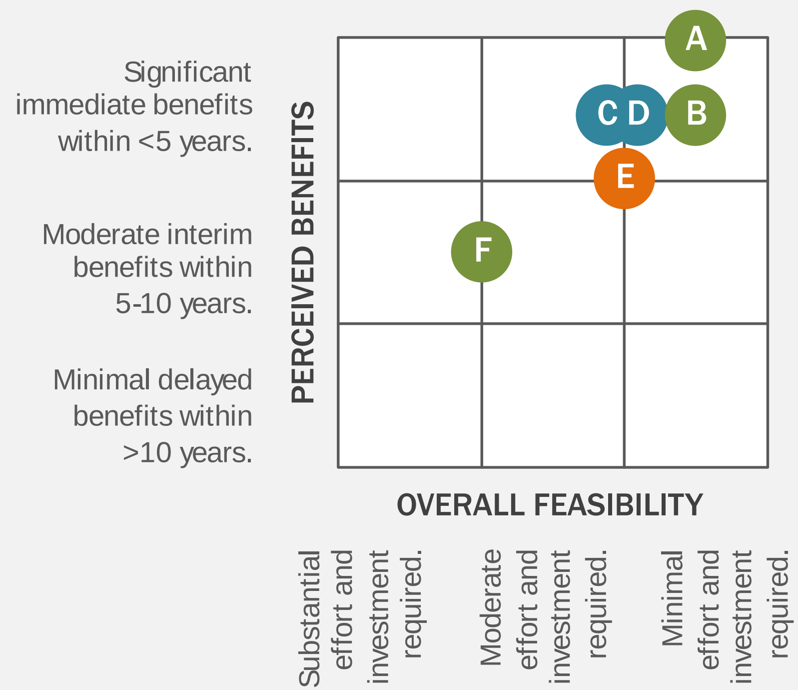
PROPOSED PROCESS IMPROVEMENTS

This shows the recommendations for sustainable design improvement, identified below, mapped against the design process and over the current process needs shown above.



FEASIBILITY vs BENEFITS

This shows the recommendations divided by their expert scores for technical and economic feasibility vs sustainability and strategic benefits.



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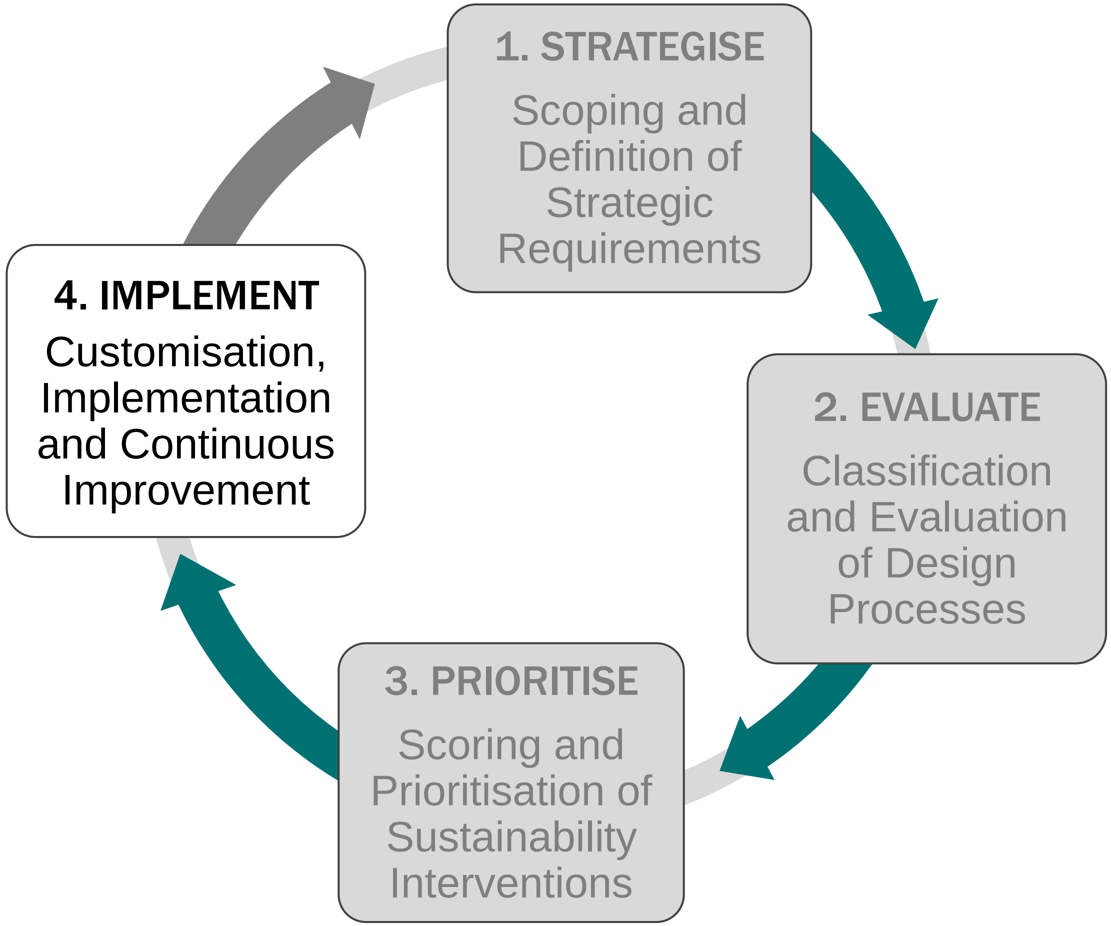
Phase 4. Implement

CUSTOMISING AND IMPLEMENTING DESIGN IMPROVEMENT PROJECTS

During this stage, the company should take forward recommendations for improvement from the previous stage, and tailor their approaches to fit within their existing processes as identified.



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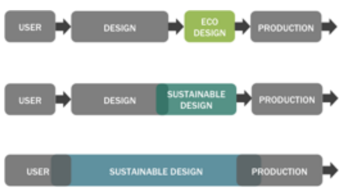
Sustainable Design Improvement in a Nutshell

WHAT CAN YOU DO TO IMPROVE SUSTAINABLE DESIGN PRACTICE?



- Promote a **considered evolution** in capability through a **strategic expansion** in sustainable design practice across the business.
- Follow these top-tips for success:
  - Improved collaboration, and **interdisciplinary communication** between key design actors.
  - Appropriate methods for **access and sharing of** relevant sustainability **knowledge.**
  - Improved **metrics** for measuring sustainable design success.
- **Get in touch** with us to see how we can help!

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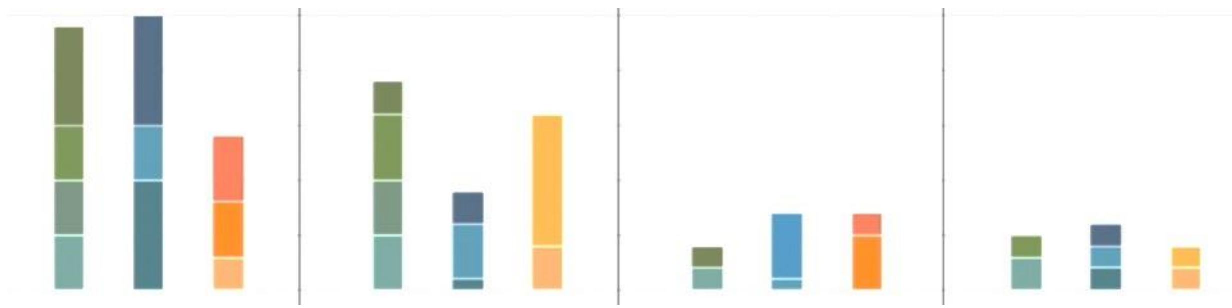
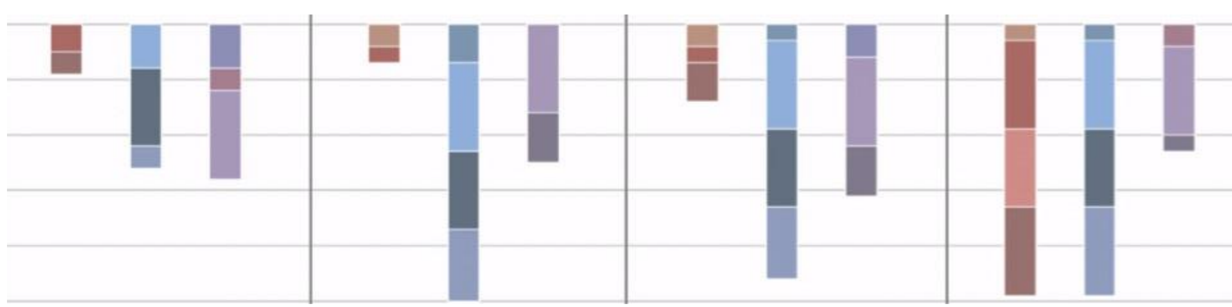


Thank you… Any Questions?



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Technical Seminar Series

16.00-16.45, 3rd December 2015

Eco-intelligent process monitoring

Elliot Woolley, Alessandro Simeone and Nick Goffin

Loughborough University

This webinar will demonstrate the role that sensing technologies can play in providing real time data to improve environmentally-aware short term decision making. The talk will be in three parts:

- A general overview of eco-intelligent manufacturing, and its widespread applicability to industry
- The novel use of vision sensors for reducing the duration of clean-in-place processes (relating to the food sector)
- The novel use of laser diffraction for ensuring optimised production of thin film solar cells

The webinar will therefore cover a mixture of theory and experimental investigation which should be thought provoking and lead to an engaged discussion regarding the role of eco-intelligent manufacturing in modern industry.

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