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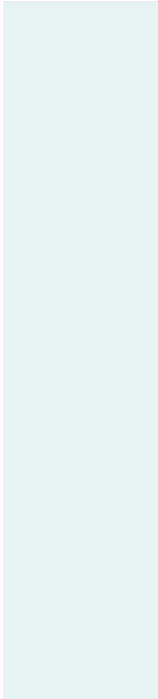
Reduction of Logistics and Packaging Costs

STEELCASE MANUFACTURING MALAYSIA (SMM) X SUTD
CAPSTONE 7 | PROJ 61

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- 
1. Team Introduction
 2. Company Overview
 3. Initial Problem Statement
 4. Needs & Requirements
 5. Precedent Analysis
 6. Direction
 7. Exploration
 8. Task Allocation
 9. Timeline

1. Team Introduction

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our TEAM

ESD PILLAR *Engineering Systems Design*



Yuan Nan



Tirtho



Hoang Nam



Basil

EPD PILLAR *Engineering Product Design*



Hui Wen



Xiao Qi



Herlinda

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2. Company Overview

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Global Leader in
Office Furniture,
Interior Architecture
&
Space Solutions
for Offices, Hospitals
and Classrooms

Inspired by Innovative
Research in Workspace
Design



Sustainability is one of
their Key Goals

Products

CHAIR PRODUCTS



Products

MECHANISMS



3. Initial Problem Statement

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Stakeholders

Company

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Faisal Shaikh (Plant manager)
Ed Vanderbilt (Leader, Innovation)
Inderjit Singh (Director)
Guat Mei – (Operation Engineering)
Celine – (Purchasing)
Suresh – (Material Management)
Zainurian – (Material Management)
Aditya Bajpai – (Procurement)
Ganeson Ramiah – (Procurement)
Tsok Yee (Import/Export Compliance)
Carey Cheong (Order fulfillment)
York Ping (Operation Engineering)

Workers



Supplier



Problem Statement

SHIPMENT



Analysis of Inbound/Outbound Shipment Data



Optimise Inbound and Outbound Shipment Operations



Leverage any Tax Laws to Reduce SMM's Overhead Cost.



Quantify the Resource Savings

PACKAGING



Increase Packing Efficiency



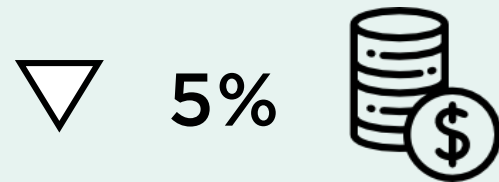
Accommodate Different Product Lines



Improve Ergonomics of Package Handling

Goals / Deliverables

SHIPMENT



BONUS:



PACKAGING



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Problem Approach

Warehouse Cost Reduction

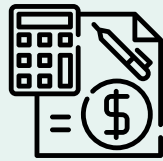


Optimise Product Quantity



Predict Distribution of Product Demand

Need: Demand Data, Warehousing Cost, Backorder Cost, Etc.



Shipment Route Optimizations



Combine/Redesign Shipping Routes

Need: Current Shipment Route, Travelling Time, Shipment Size, Product Type



Warehouse Layout Optimization



Optimise Product Placement

Need: Demand Data, Current Warehouse Layout

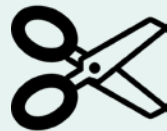


Problem Approach

Material Reduction



Decrease Amount of Material Used through Redesign



New Material



Use Material with Higher Durability



Use Material Less Energy-Intensive in the Production/ Recycling Stage of its Life Cycle



Assembly Time Reduction



Decrease Time Needed to Assemble the Packaging



4. Needs & Requirements

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Needs & Requirements

TEST REQUIREMENTS



Drop Test



Weather
Simulation

PACKAGING REQUIREMENTS



Assembly of
Packaging: Time-
efficient & Easy



Ergonomics of the
Packing Process

MATERIALS REQUIREMENTS



Eco-Friendly



Cost-Effective



Protects Product



Readily Available
in Malaysia by
Local Suppliers

Constraints

PACKAGING OPTIMISATION CONSTRAINTS

Unable **to Do Frequent Site Visits to Confirm Hypothesis/ Test Out Designs Proposed**

Limited **Data Regarding Disassembly of Products for Packaging Purposes**

Limited **Data Regarding Product Structure, Design & Material Breakdown**

5. Precedent Analysis

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Preliminary Data Summary

Outbound data

- Records for SCAP Asian outbound air & ocean shipment information from 2016-2017.
- Volume shipment report from 2015-2017.

Inbound data

- Monthly Asian and European inbound shipment report from 2014 to 2018.

Products and Mechanisms packaging

- Pictures of the current products.
- Pictures of how the components (mechanisms & arms) of the products are packaged.

Preliminary Data Summary

Packaging costs

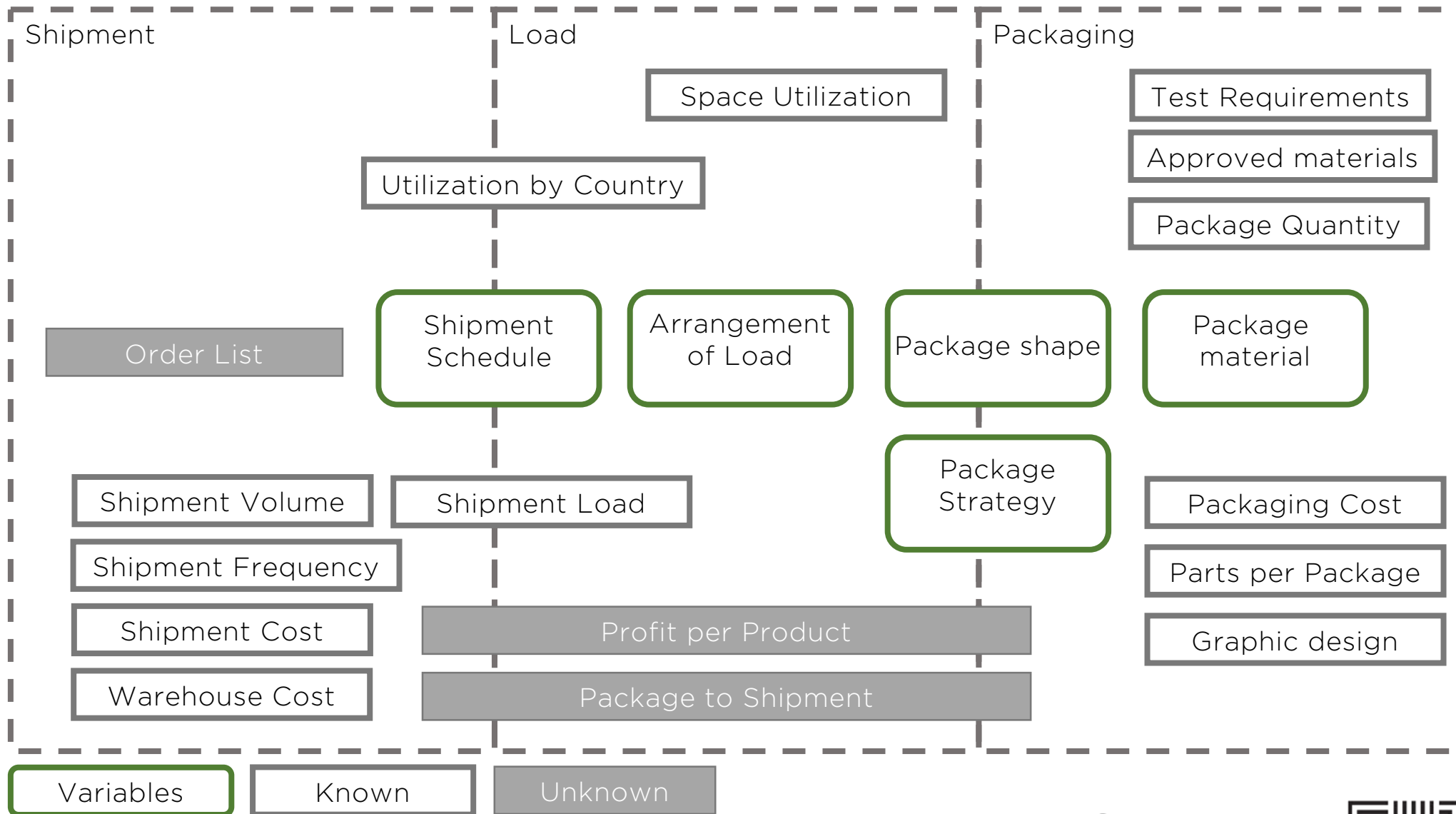
- The packaging cost break down for each type of the products from Mar 2017 to Jan 2018.

Container utilization

- The packaging space utilization data for different products.

Loading report summary

- Records of container utilization based on country(2016-2018).
- Container utilization ratio comparison.
- Factor of low utilization.



Analysis On Current Packaging

Limited Reusability of Cardboard Boxes

Labour Intensive to Fold & Pack Each Product Individually

Low Packing Efficiency in Current Methods (~28.6%)

Mechanisms Take Up Bulk of Their Total Packaging Cost

6. Direction

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Direction

LOAD	OPTIMISATION	PACKAGING
Optimising Container Space	Improve Packing Efficiency	Redesign Packaging
Reduce No. of Containers Used & Trips Needed		Increase Lifespan of Packaging

7. Exploration

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Material Exploration



**Mushroom packaging,
Fungal Mycelium**
(by Ecovative)



Lactips



AgroResin

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Design Exploration



**Protective slots
(space wastage)**

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Design Exploration



The Rapid Packaging Container



Tessellating Shapes Packaging

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Space Optimization Exploration

PROPOSED ALGORITHM: **Largest Area First-Fit (LAFF)**

Algorithm Input

Number **of different-sized Box**

Width **of box**

Height **of box**

Depth **of box**



Algorithm Output

Used **Space**

Wasted **Space**

M.Zahid G ,rb ,z , Selim Akyokuş, İbrahim Emiroğlu, Aysun G ,ran. (2009). An Efficient Algorithm for 3D Rectangular Box Packing. *Applied Automatic Systems: Proceedings of Selected AAS 2009 Papers*
N. Chernov, Yu. Stoyan, T. Romanova. (2010). Mathematical model and efficient algorithms for object packing problem. *Computational Geometry*

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8. Task Allocation

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Task Allocation

	B	T	HN	YN
Data aggregation and cleaning				
Exploratory analysis				
Statistical analysis				
Hypothesis testing				
Construction of optimization model				
Model validation				
Results validation				
Sensitivity & Trade-Off analysis				

B: Basil Yap

T: Tirtho Sarker

HN: Hoang Nam

YN: Yuan Nan

Task Allocation

	H	HW	XQ
Analysis of current packaging and space usage			
Background research			
Research evaluation and analysis			
Materials sourcing			
Design documentation			
Conceptualization of ideas			
Concept models			
Prototyping and testing			
Test results analysis			
Evaluation of prototype			

H: Herlinda

HW: Hui Wen

XQ: Xiao Qi

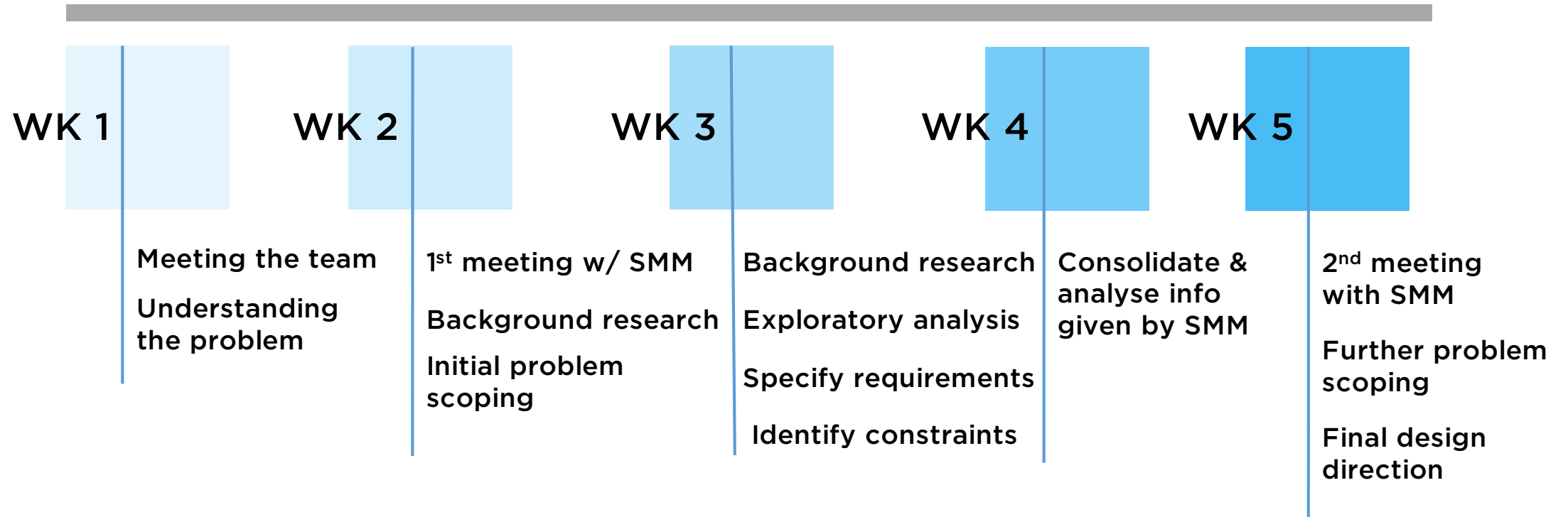
9. Timeline

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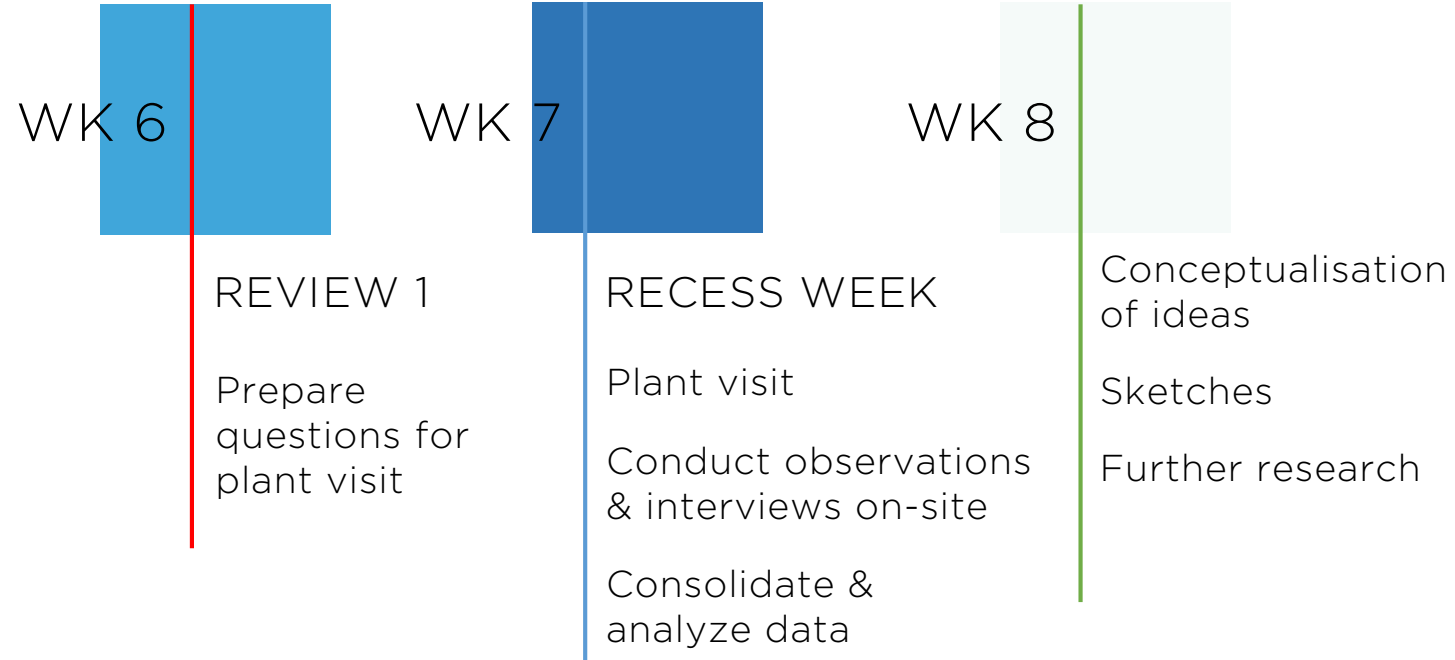
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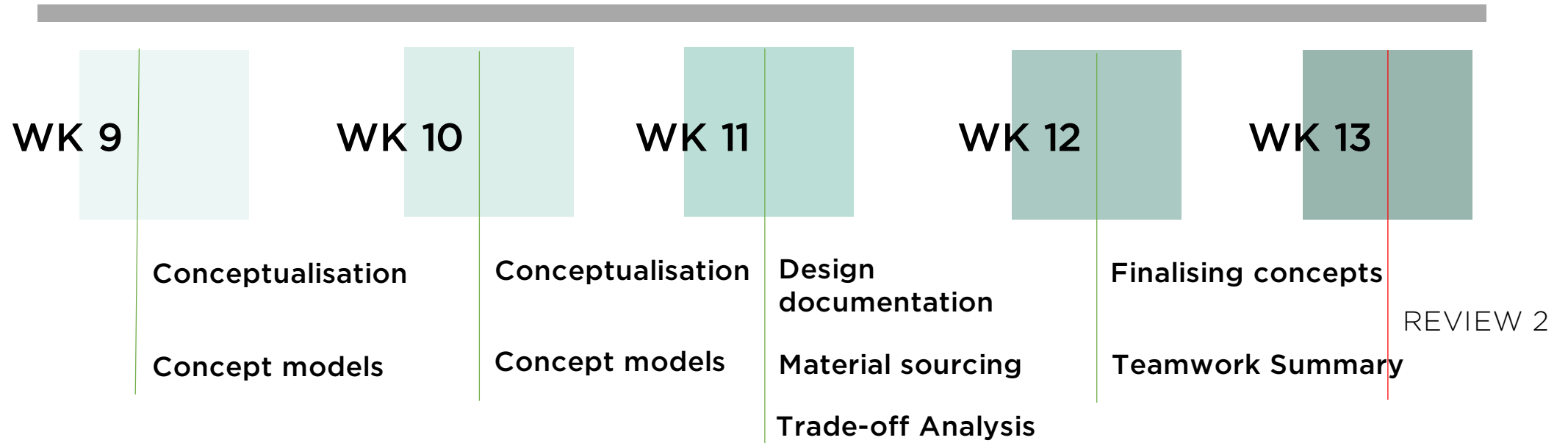
Timeline



Timeline



Timeline



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