
# Chain of Wastes: The Moderating Role of Making-do

Marcus Fireman – PhD Candidate at UFRGS

Tarcísio Saurin – Professor at UFRGS

UFRGS
UNIVERSIDADE FEDERAL
DO RIO GRANDE DO SUL

NORIE
Núcleo Orientado para a Inovação da Edificação

# Introduction

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- **Chain of Wastes** has been used to describe the **systemic impact** of some types of waste
- **Making-do** has been cited as a **primary waste** that triggers other wastes, creating a Chain of Wastes in construction

**Chain of Wastes are nonlinear** – Small wastes can create large consequences

# Introduction

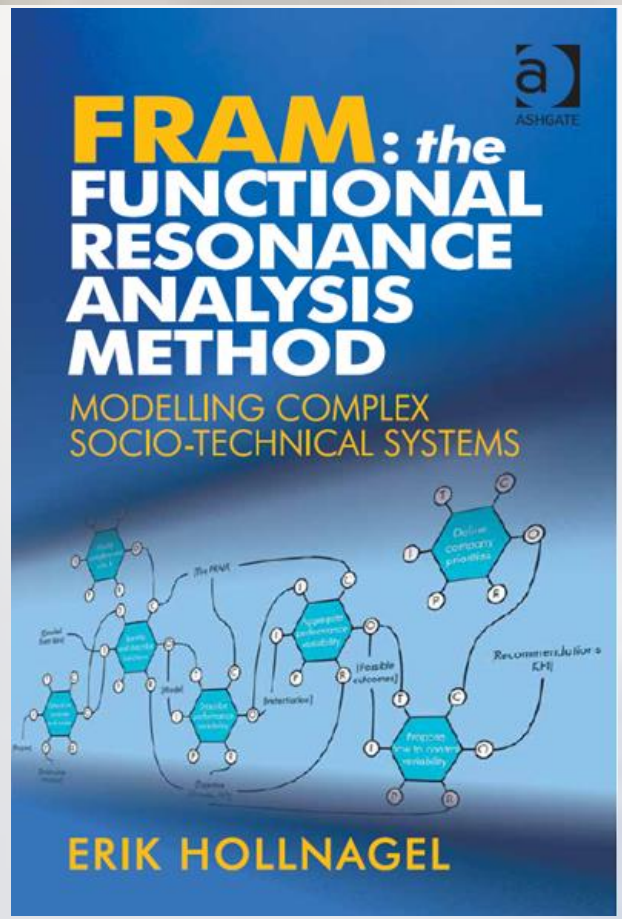


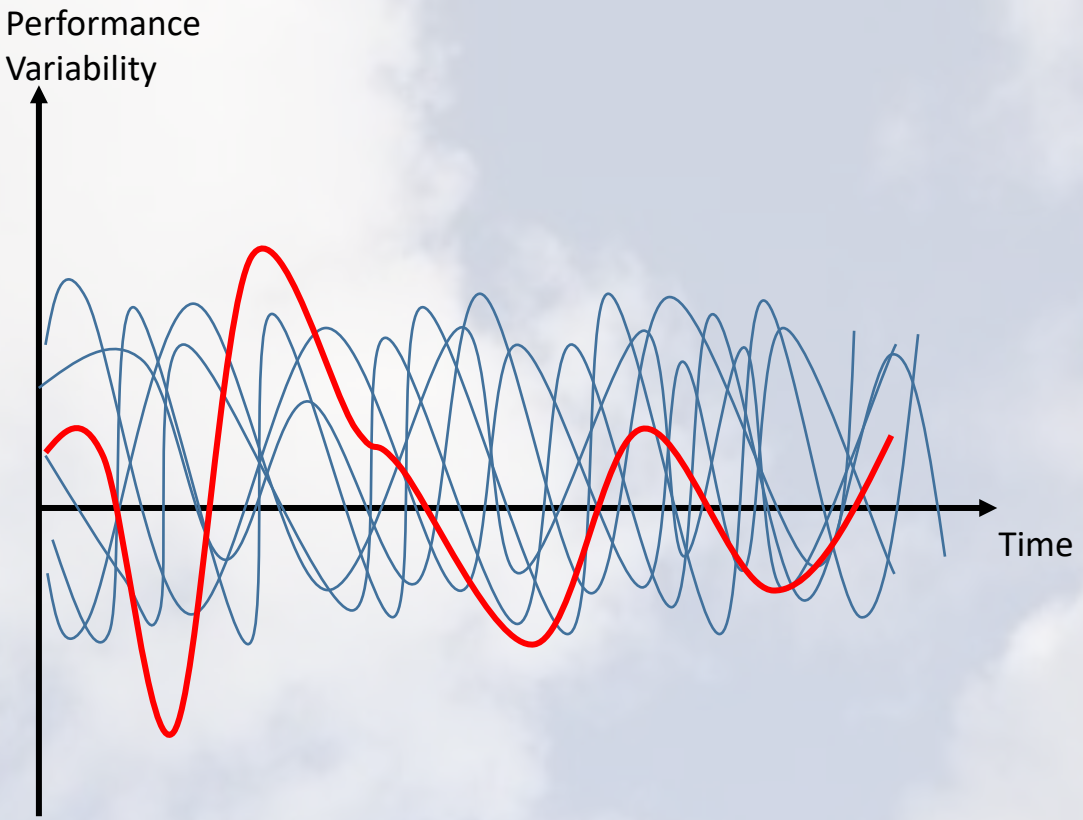
- The literature about **Chain of Wastes** is only **conceptual**, and the applicability and utility of its concept have not been properly explored

- The **Functional Resonance Analysis Method** (FRAM) could be used to model a Chain of Wastes in construction, since it **allows modelling interactions** between managerial and production functions in complex systems

# Introduction






Functional resonance is the detectable signal that emerges from the unintended interaction of the normal variabilities of many signals.

Hollnagel, 2012

# Aim of the Study



- **Analyze, based on FRAM, the role of Making-do in a Chain of Waste. This investigation is relevant for two reasons:**
  - The assumption of Making-do as a primary waste lacks empirical grounding, and
  - The notion of primary waste is elusive as usually there is no single (or primary) root causes for phenomena in complex socio-technical systems. So, it is possible that Making-do itself is underlined by other types of wastes.

# 5 Steps to FRAM Application

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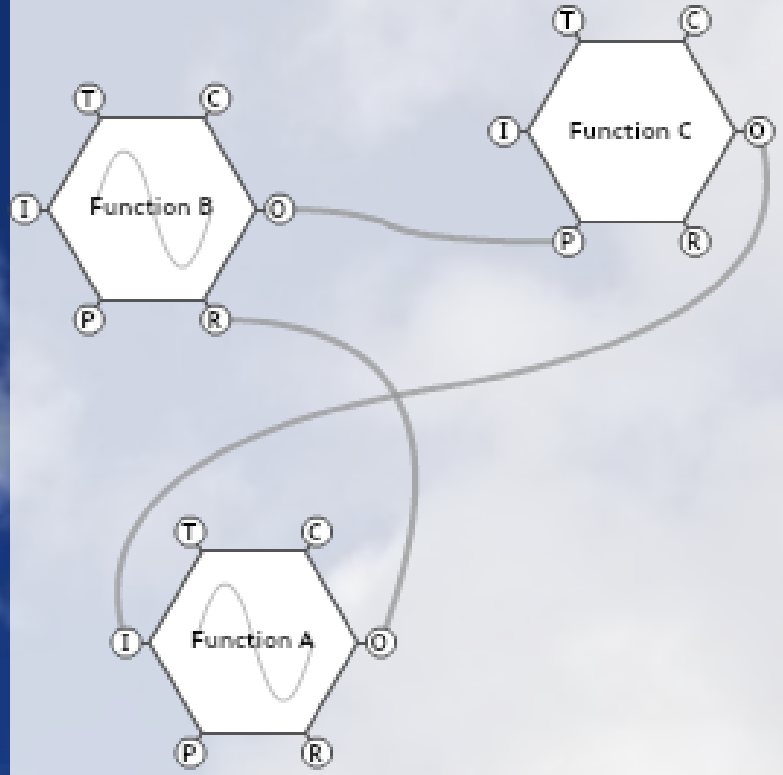
- Defining the **purpose** of FRAM analysis (Retrospective view or Risk Assessment);
- Describing the functions of the system according to **six aspects**;
- Describing the **variability of the output** of each function in terms of **time** and **precision**;
- Modelling how variability can **propagate across** the system, being either amplified or dampened
- **Devising practical solutions** for improving the work system design.



# Research Method

## Case Study

**Airport Terminal** – 29,500 m²
**Company X** – Designs, Manufactures and Assembles Metallic Structures

# Research Method

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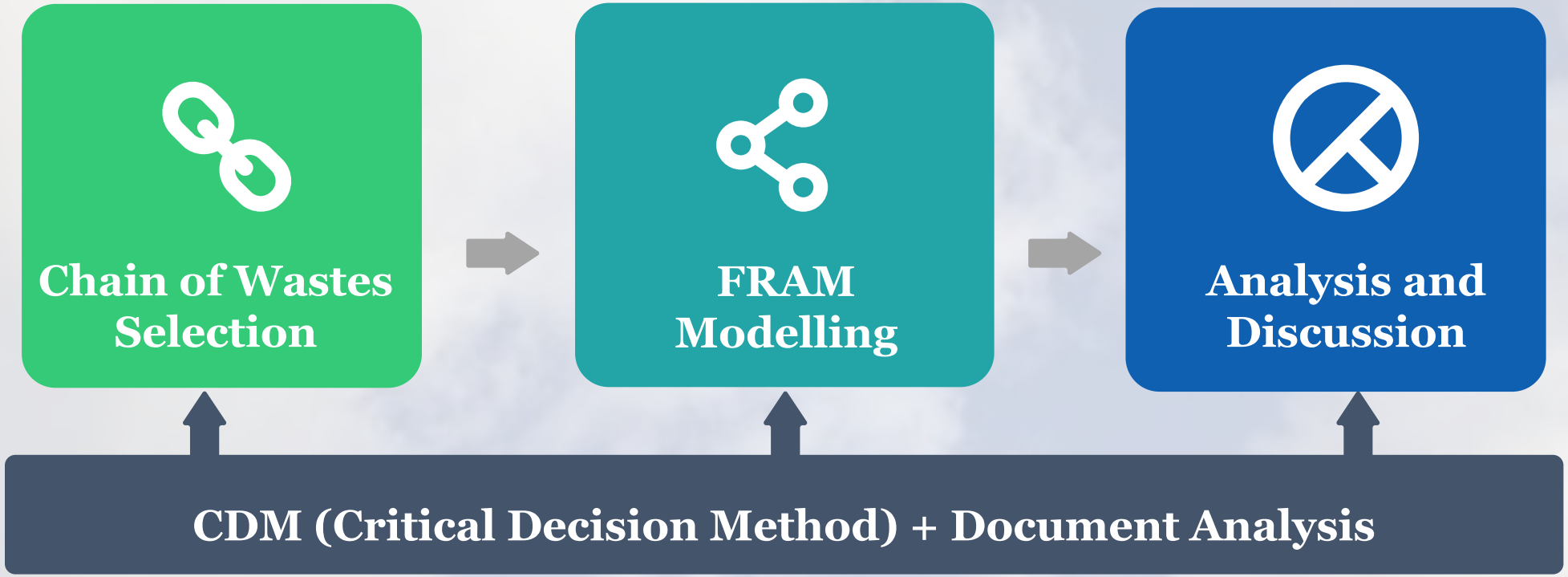
## Research Strategy



# Select the Chain of Wastes-
## Work-as-Imagined –Gutter Installation

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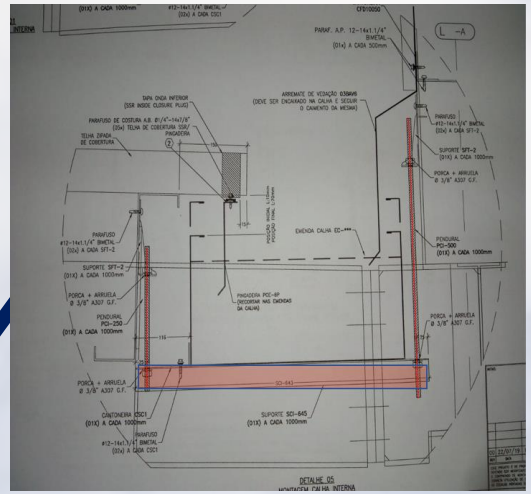
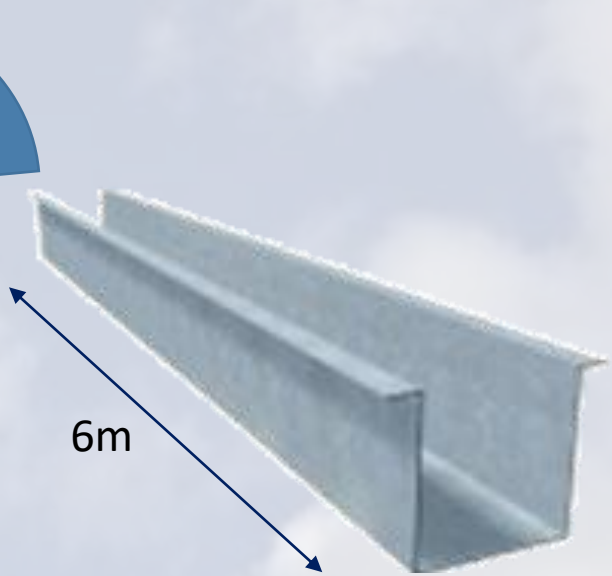
- Design
- Manufacture
- Transport
- Assemble





# Select the Chain of Wastes-
## Work-as-Done – Gutter Installation

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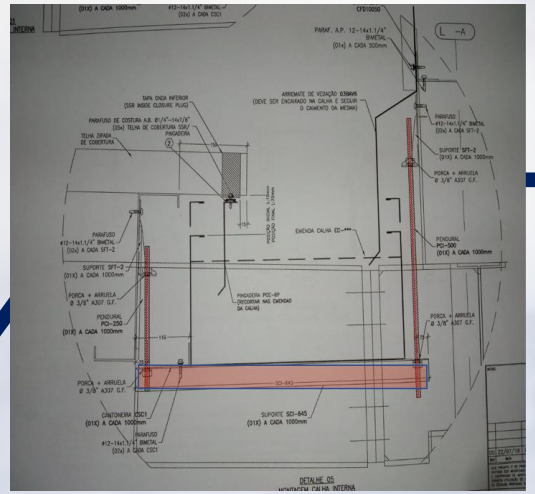
- Design
- Manufacture
- Transport
- Assemble

Failure in Make - Ready



# FRAM Modelling

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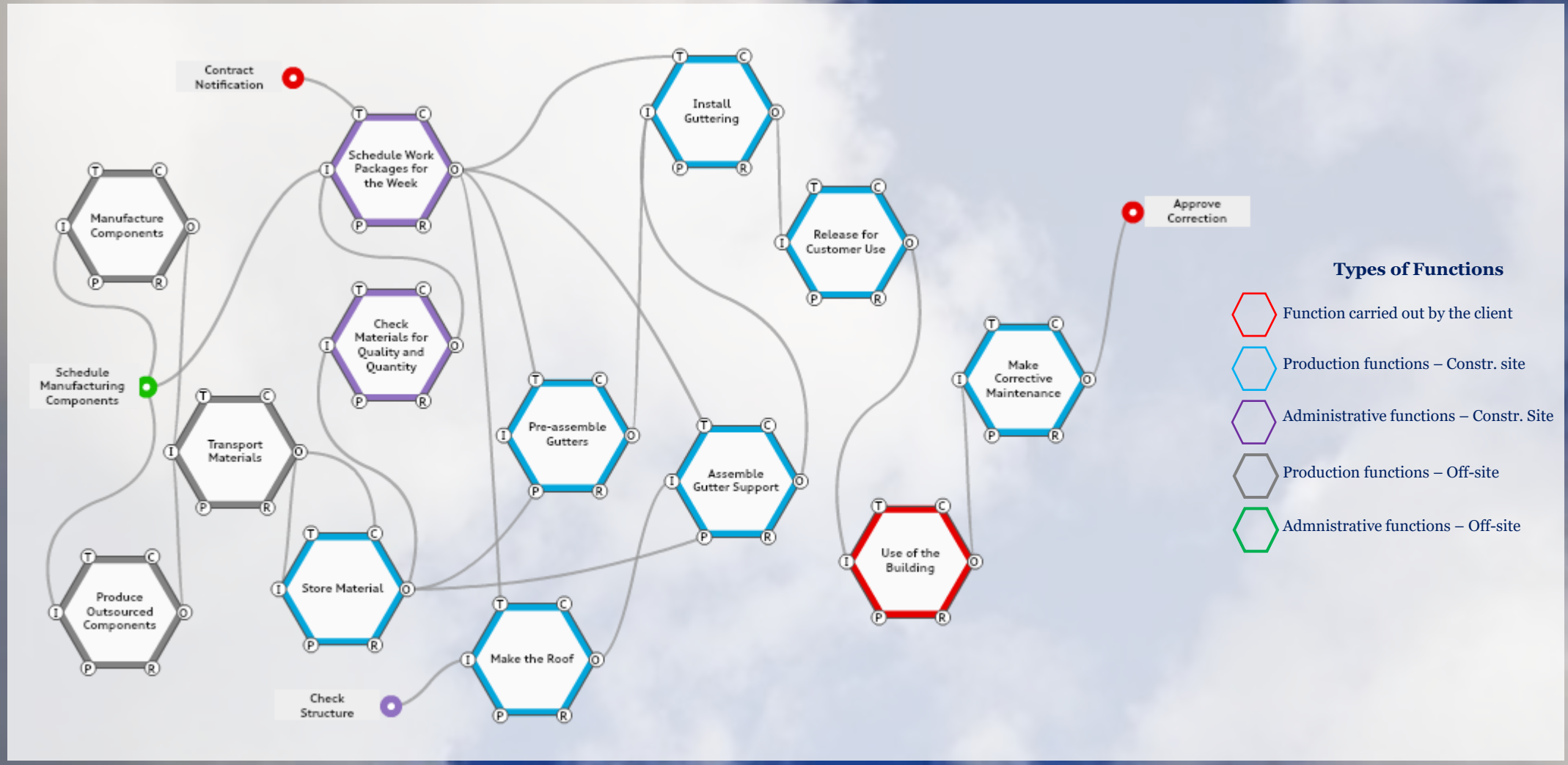

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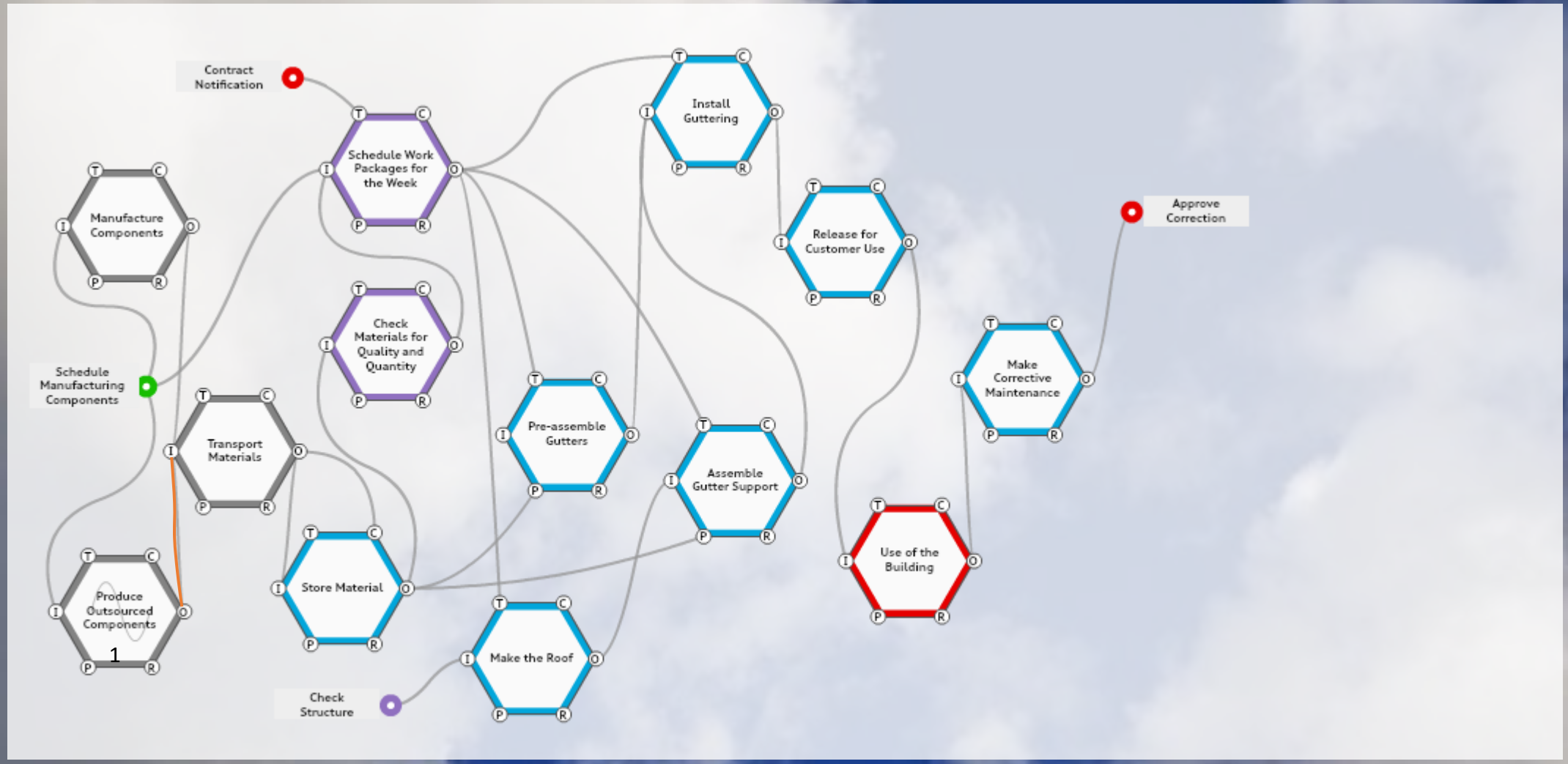

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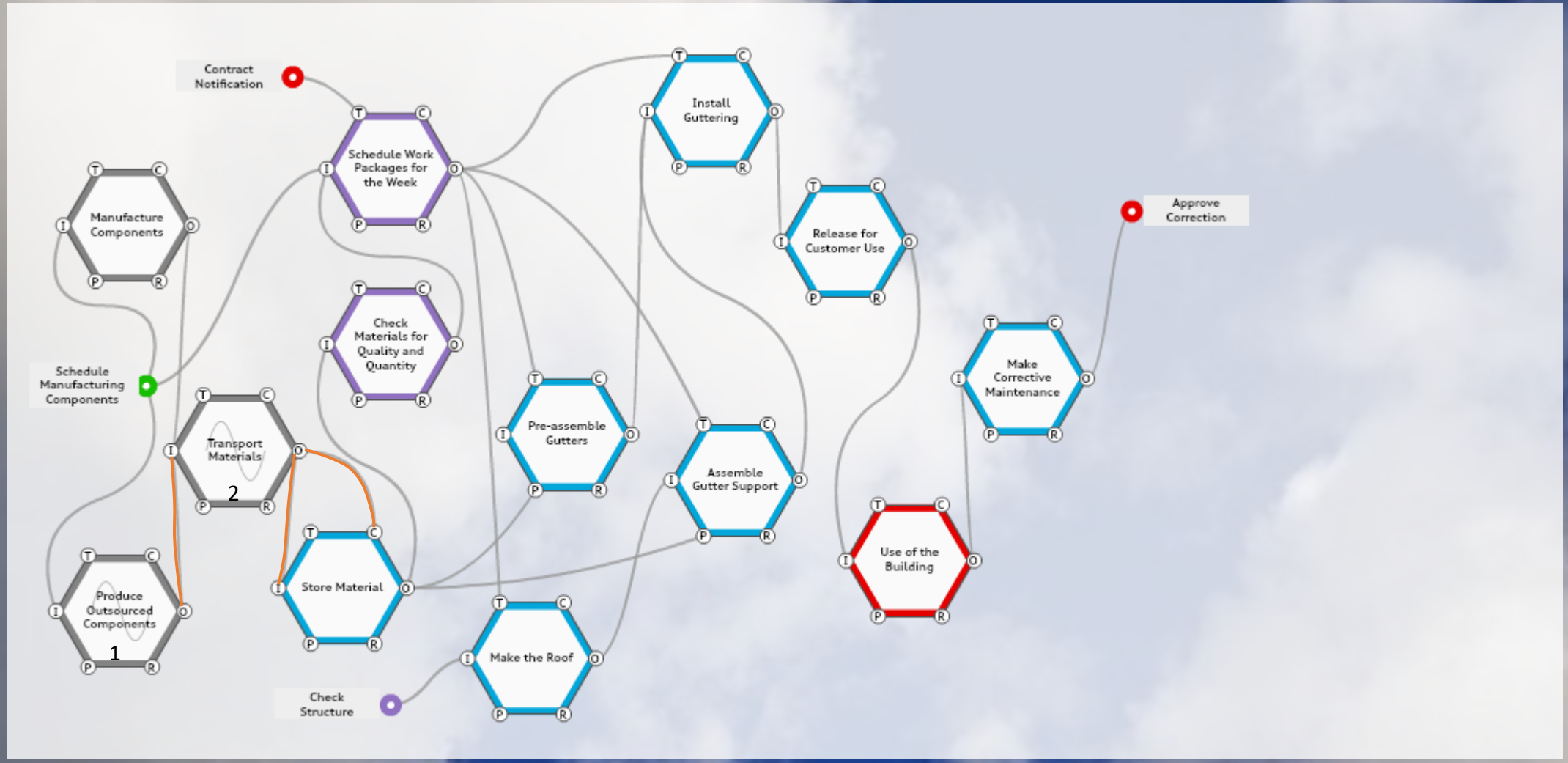

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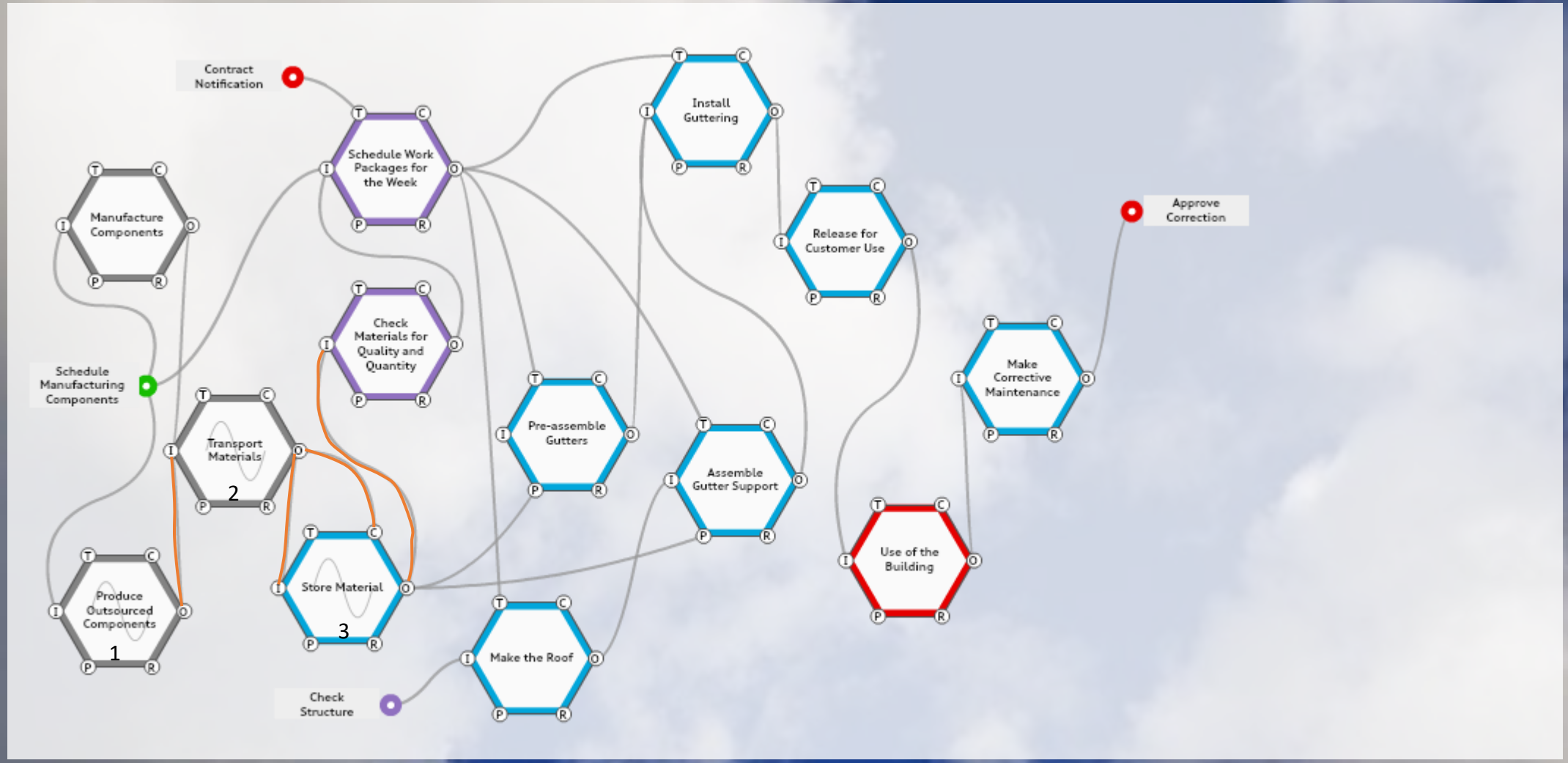

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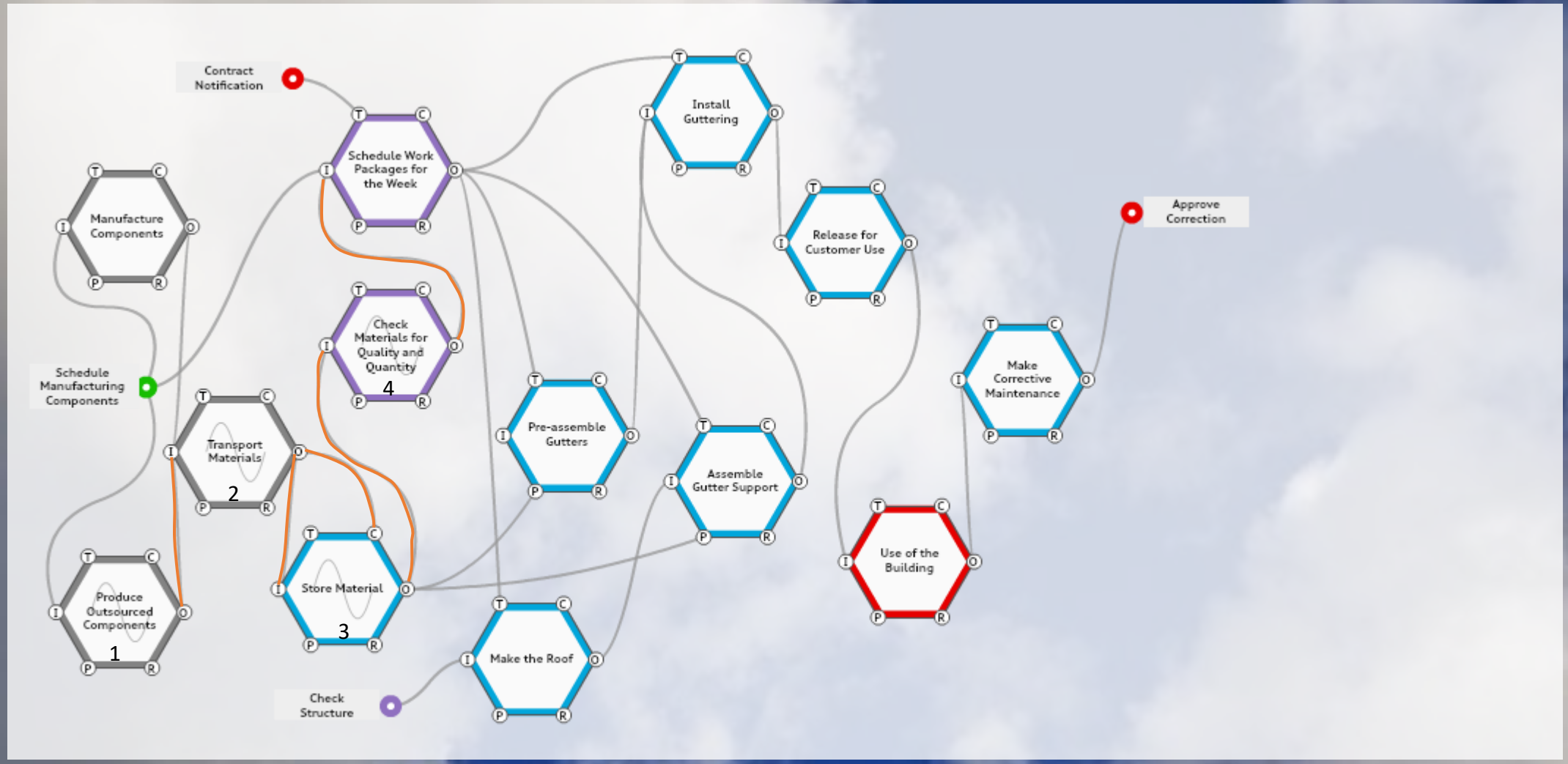

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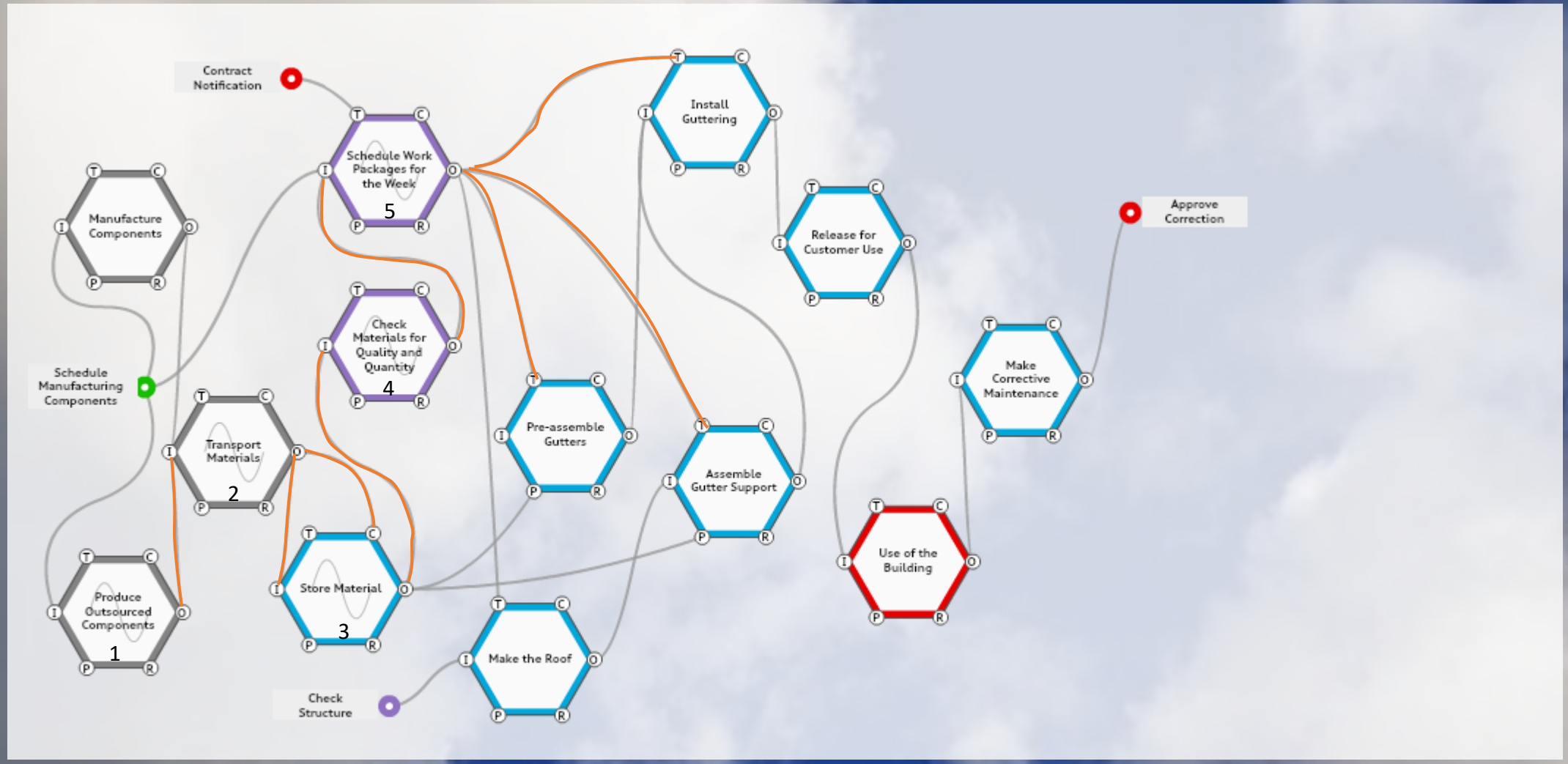

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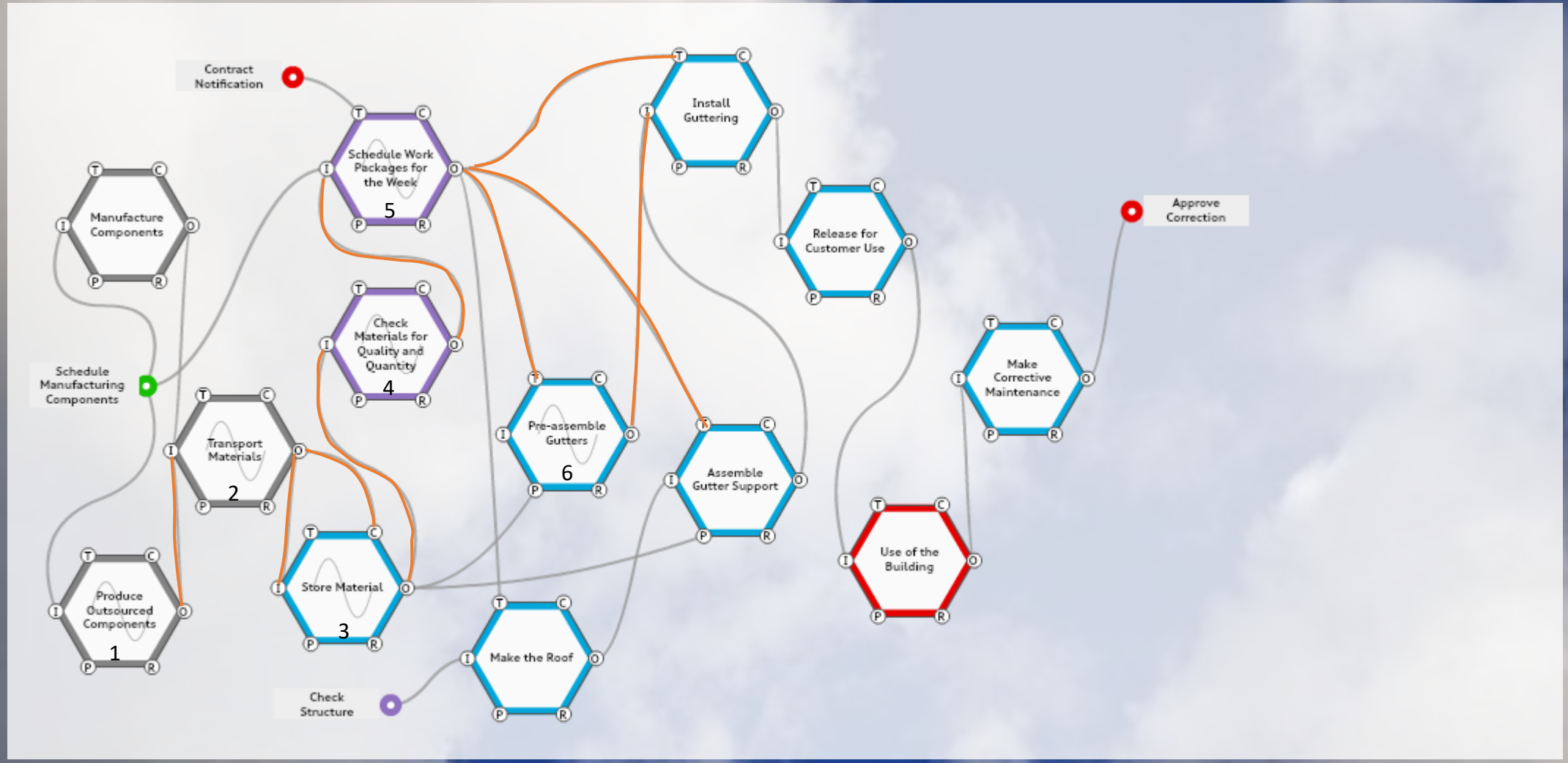

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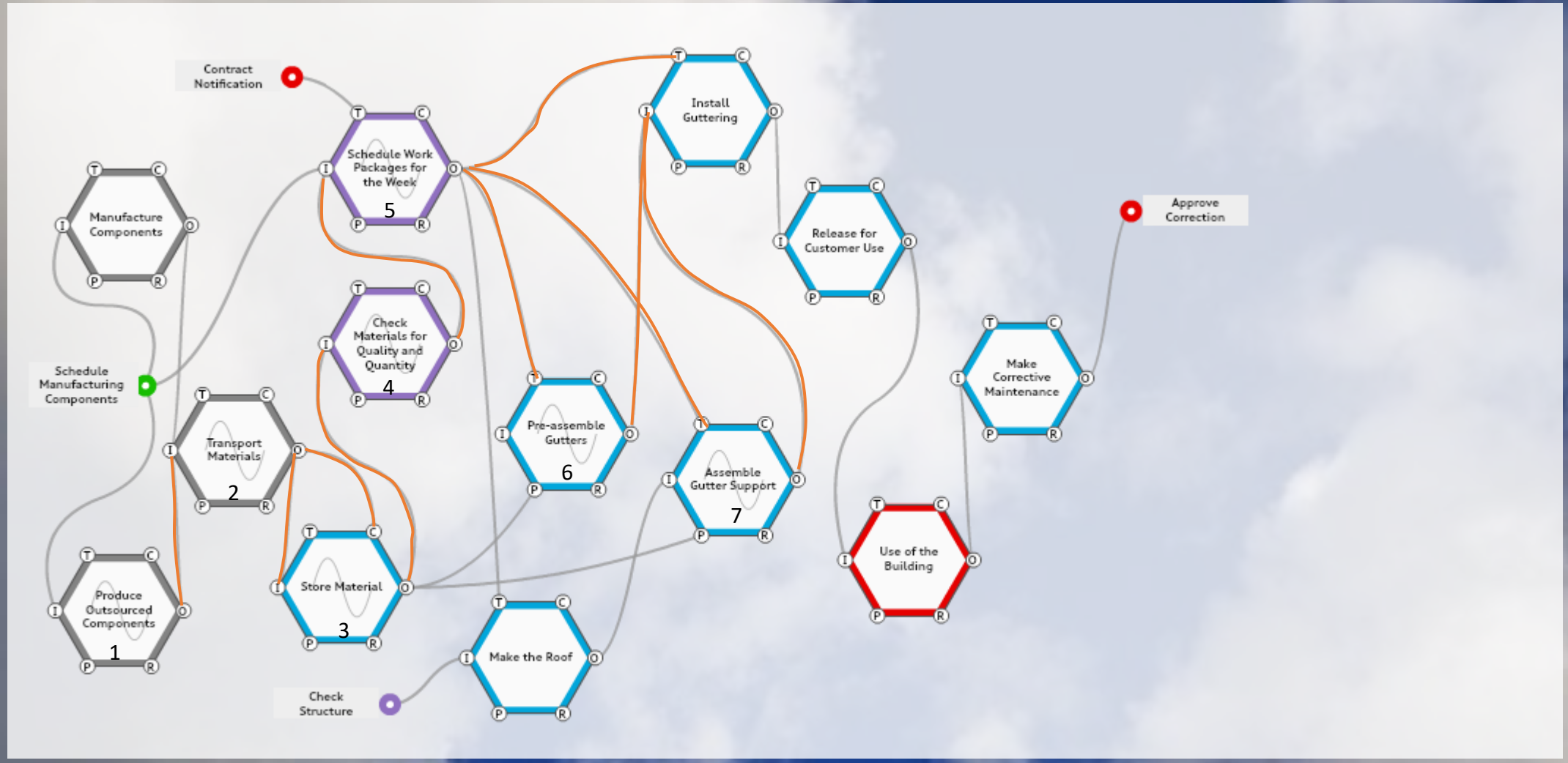

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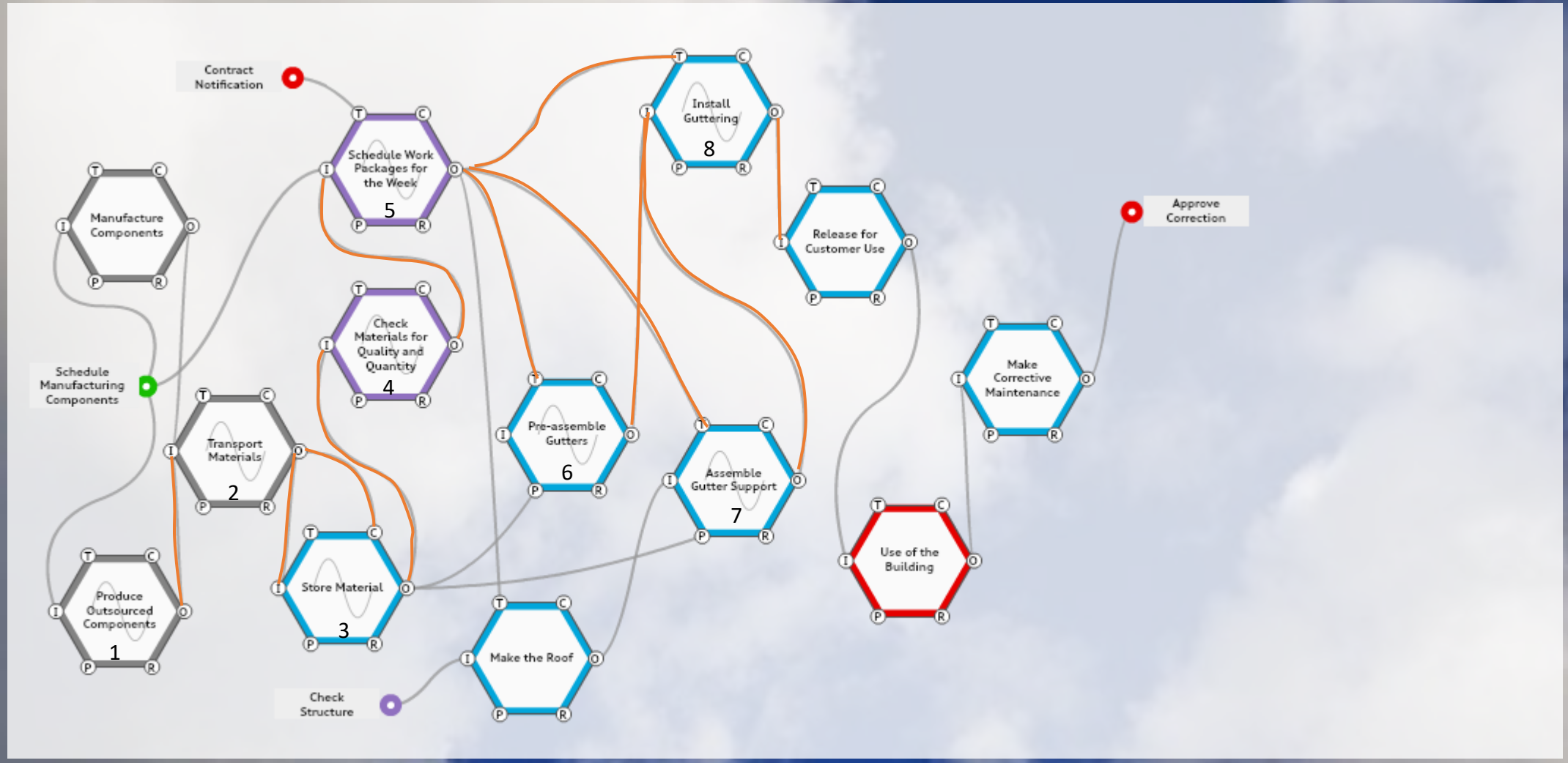

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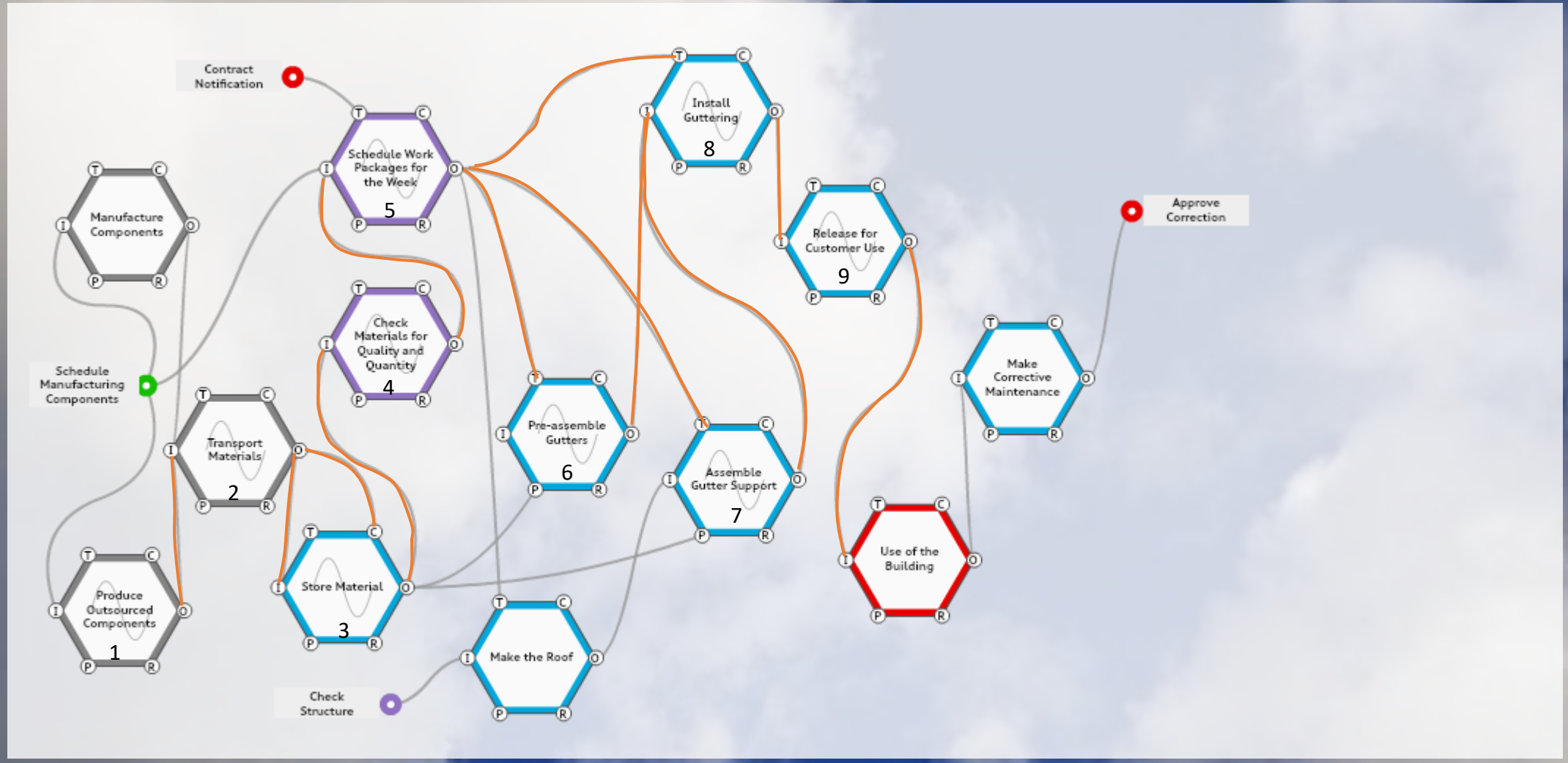

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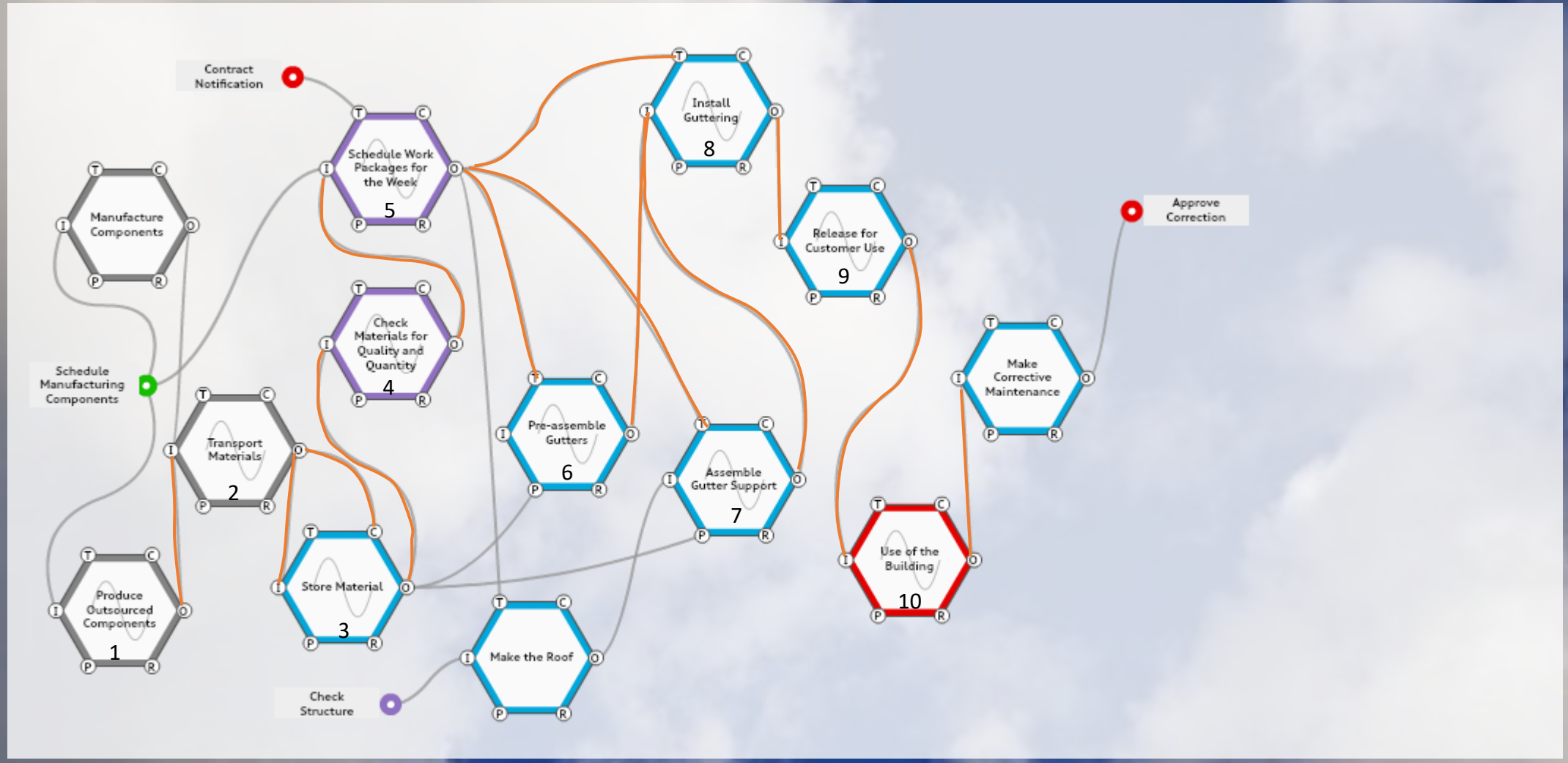

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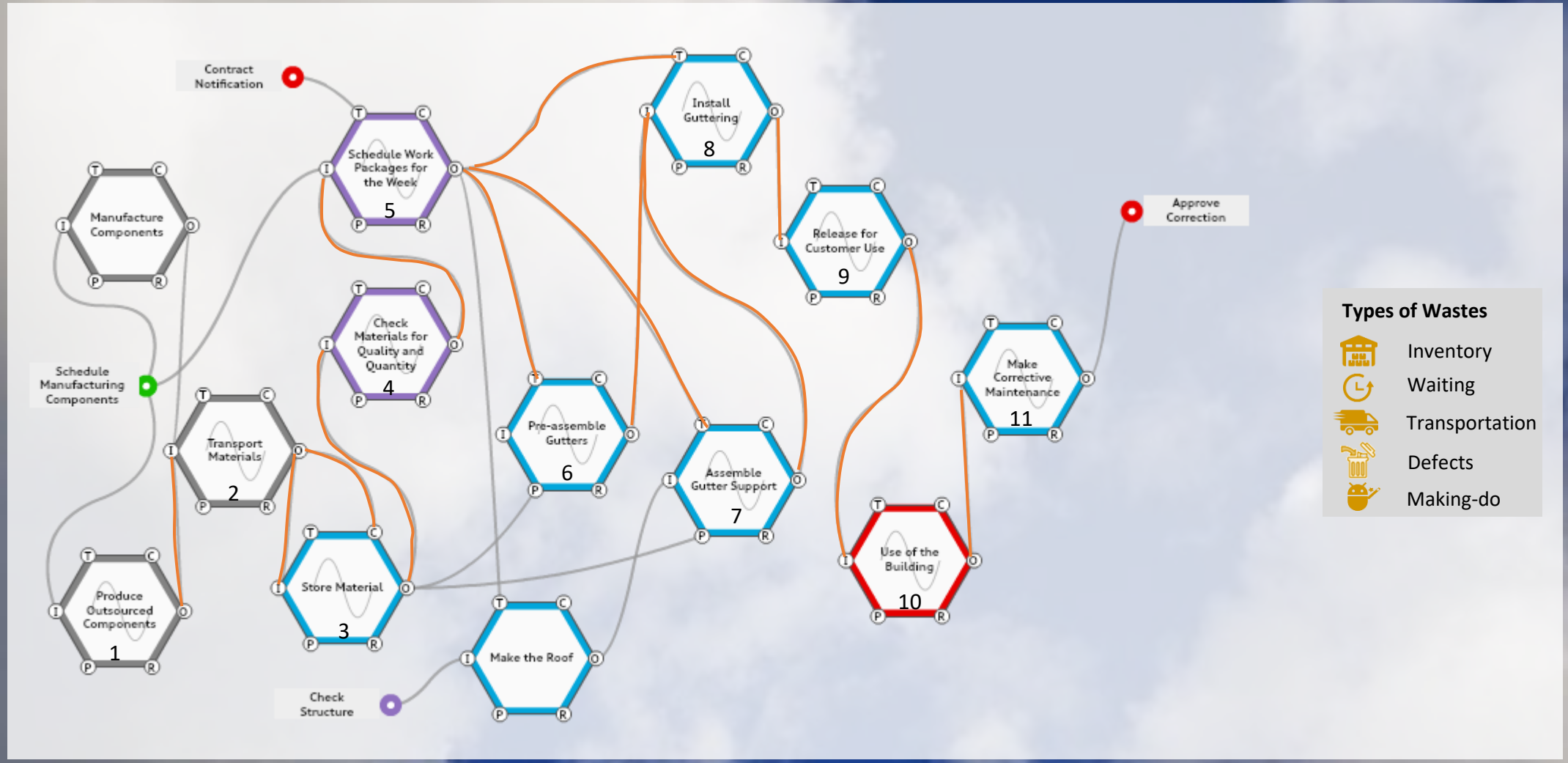

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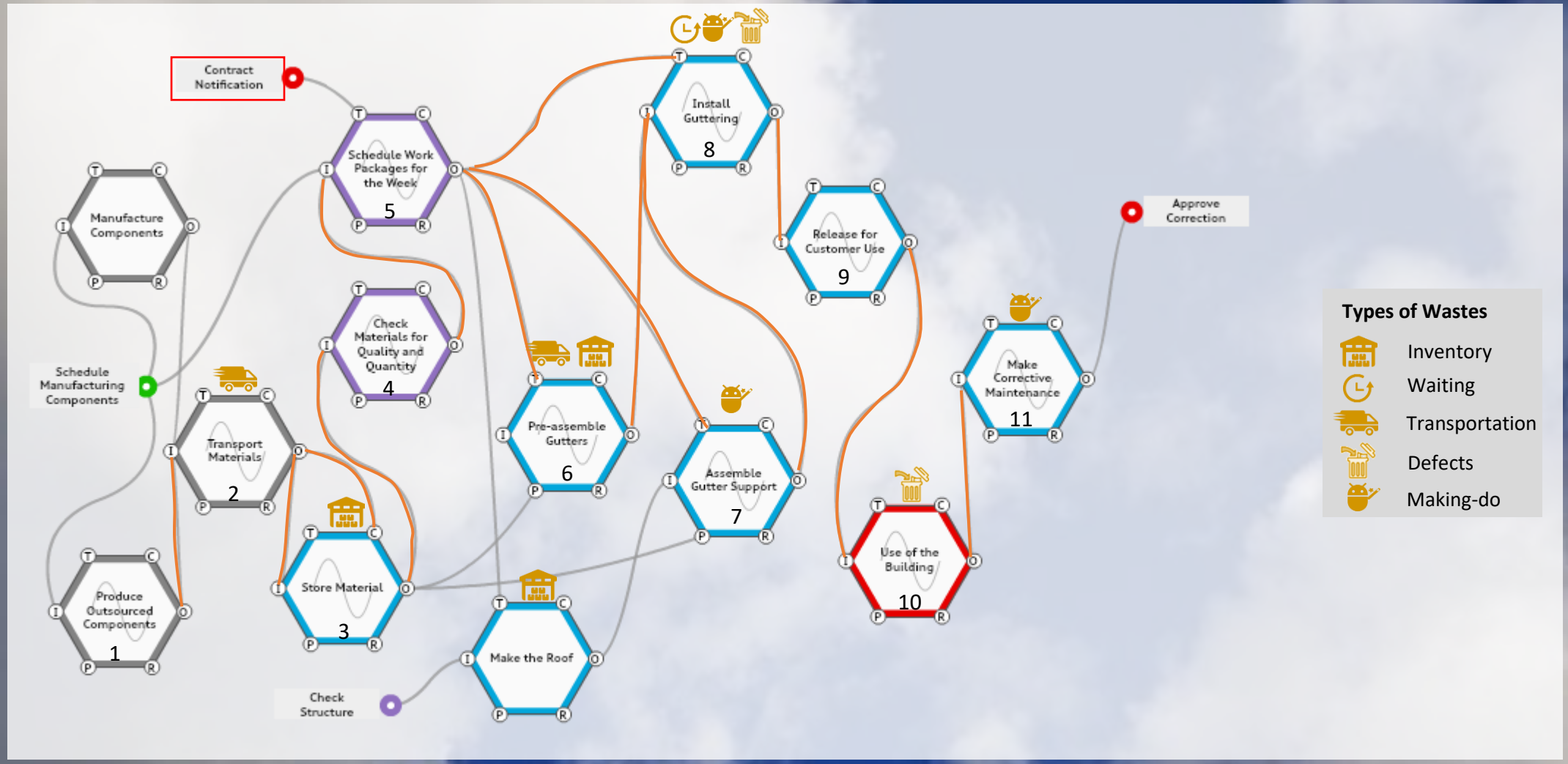

# Making-do involves a trade-off

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The **Moderating Role of Making-do** in the Chain of Wastes

# Slack as an approach to prevent Making-do



# Future Studies

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- **Cost-benefit analysis** of providing **Slack** to construction projects;
- **The use of FRAM** for investigating **Making-do** in a broader set of cases, with different levels of complexity
- **FRAM** might be used as a **Risk assessment approach** for the identification of variabilities that can give **rise to wastes**.

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# Thank you!

marcus@climbgroup.com.br

saurin@ufrgs.br