



The Use of Game-Based Learning to Teach Kanban Concept in Engineering Projects

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„Innovative Learning Approaches for Implementation of Lean Thinking to Enhance Office and Knowledge Work Productivity”

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Project Title

Innovative Learning Approaches for Implementation of Lean Thinking to Enhance Office and Knowledge Work Productivity

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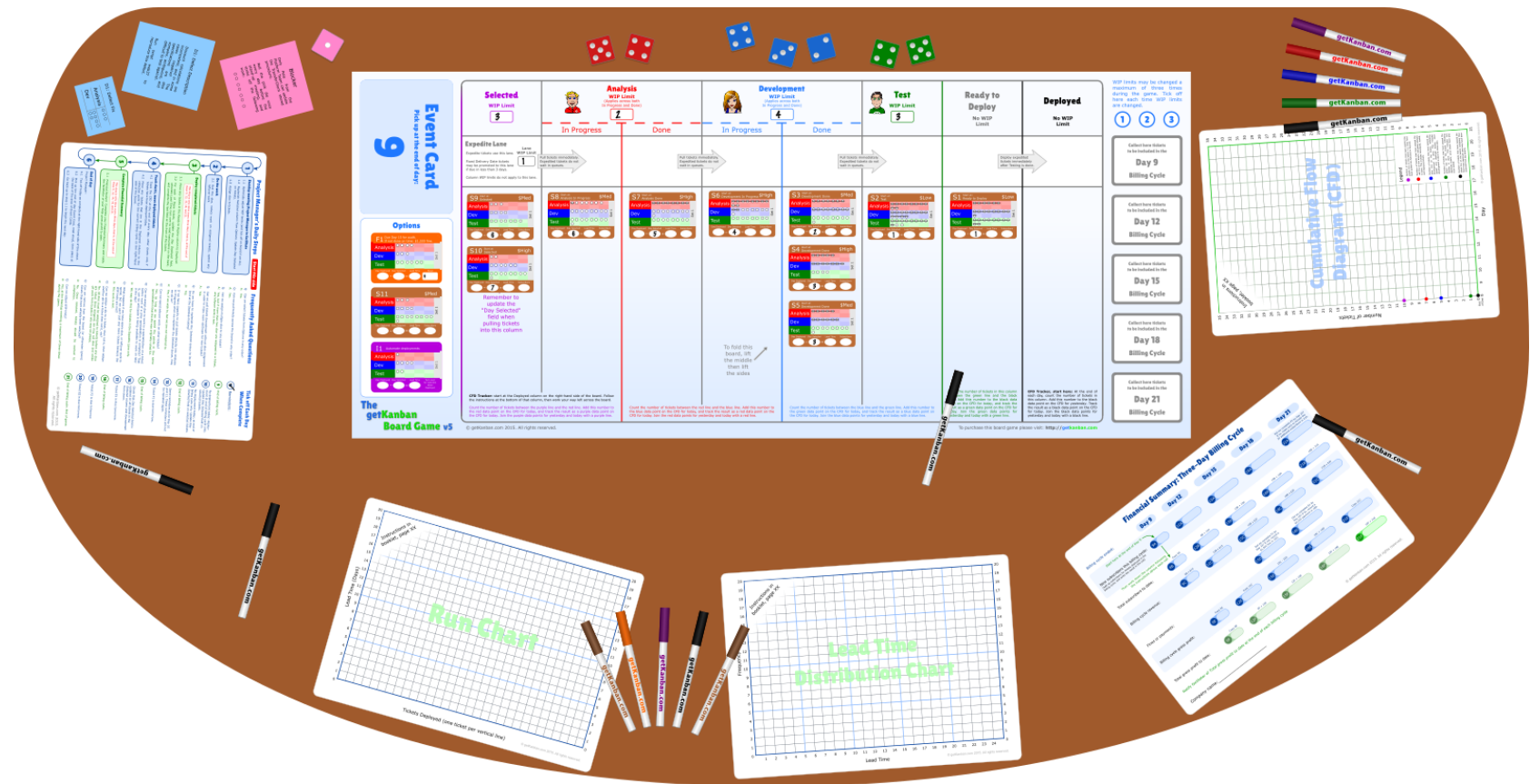
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Adaptation of *getKanban* Board Game



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Background & Motivation

Engineering companies do not put as much consideration on work-in-process (WIP) as a manufacturing company.



WIP is physically and financially invisible

Kanban is one of the ways to manage WIP, but the concept is not as prominent as in manufacturing.



This might be due to the belief that kanban is fundamentally a system for a repetitive type of production like manufacturing



While this might be true in some contexts, software industry has proved that the concept of kanban can be used in software engineering and development activities with great success



The Game Objectives

To open the eyes of any stakeholders involved in engineering activities about:

- The importance of WIP management
- The applicability of kanban in engineering activities

To achieve the aforementioned objectives by utilizing game-based learning

- To create an immersive, voluntary, and enjoyable activity
- To provide entertainment while achieving the learning objectives



What do we need to know before the game?

Kanban

WIP

RBI

6





What is Kanban?

A visual process management system that tells what to produce, when to produce it and how much to produce.

Pull system: new work is pulled into the system when there is a capacity to handle it, rather than being pushed on the system based on demand.

Kanban System

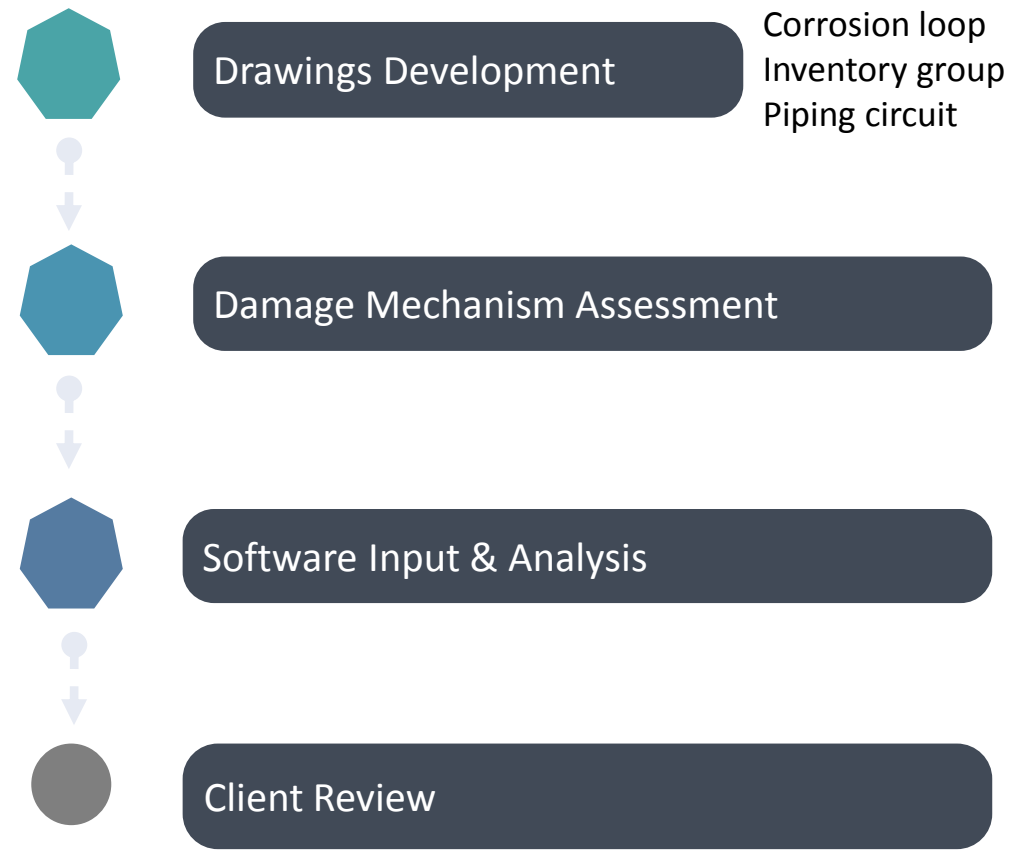
The system that is set up to track the work in process (WIP).

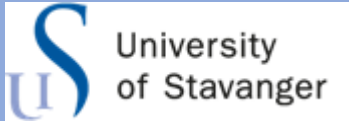
- Board
- Card
- Policies



Risk-Based Inspection (RBI)

A method used to prioritize pressurized equipment based on risk and to assess the optimum combination of inspection techniques and frequency.





Examples of Units in Oil and Gas Processing System

Hydrocarbon Units

- Wellheads & Manifolds
- Separation & Stabilization
- Crude Handling
- Gas Treatment, etc.

Flare, Drain and Utilities

- HP & LP Flare
- Closed & Open Drain
- Water Treatment
- Fuel Gas, etc.

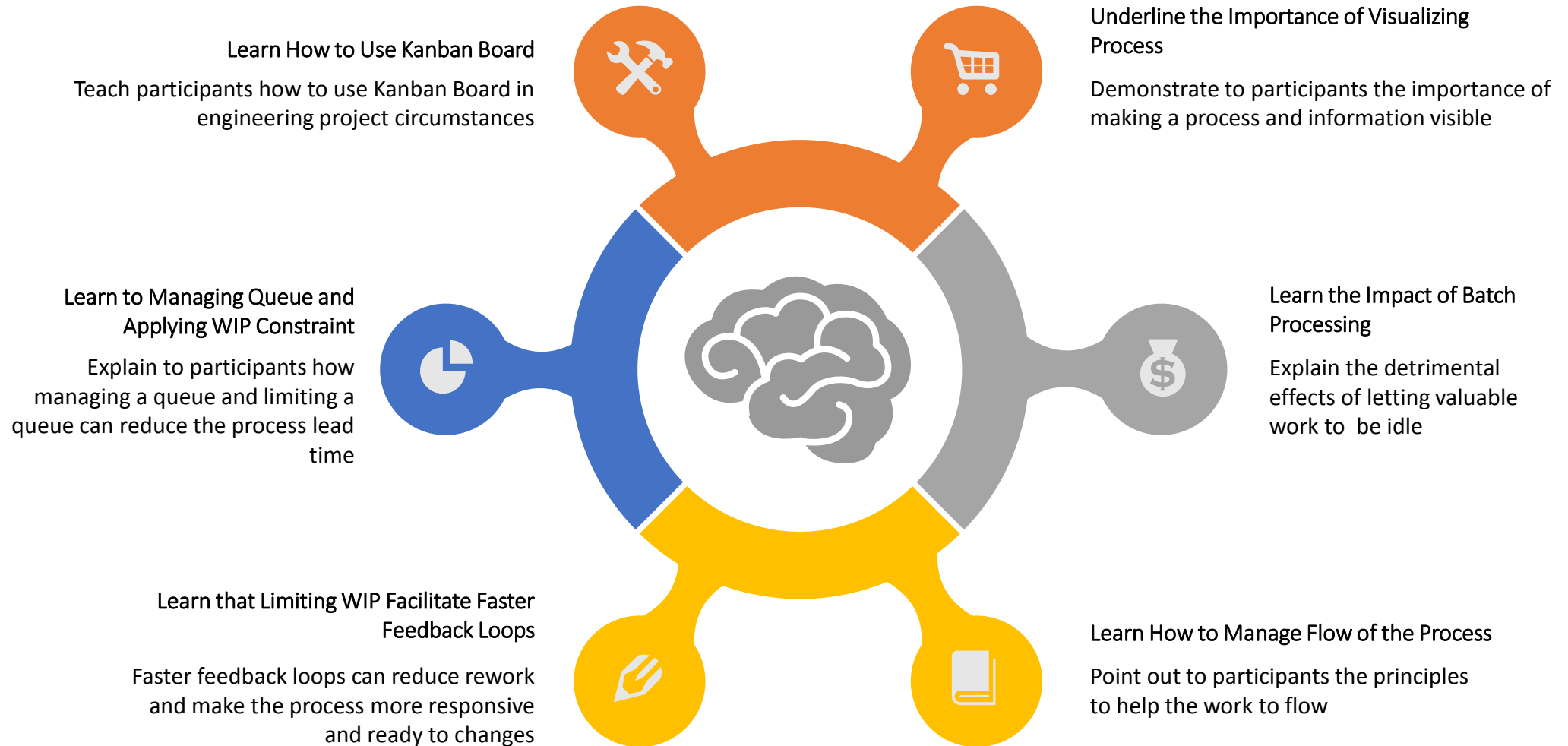
Chemical Injection and Air System

- Methanol Injection
- Air System
- Inert Gas System, etc.





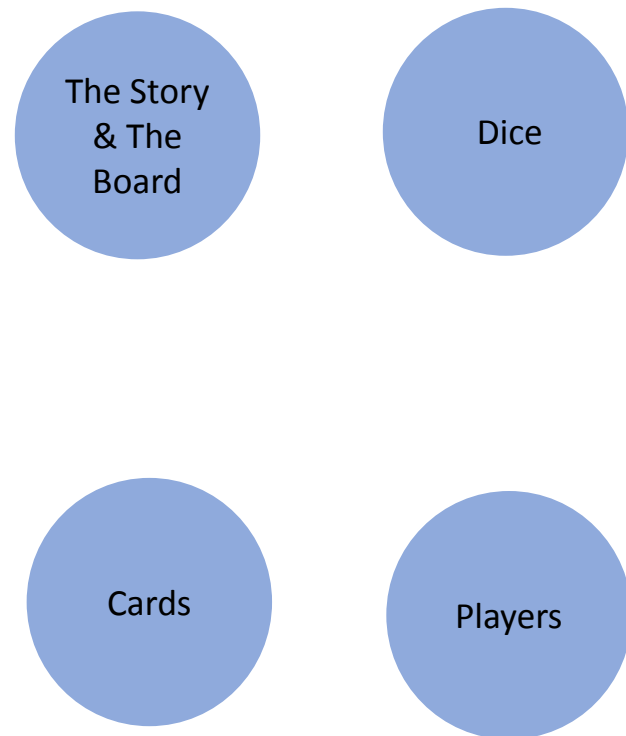
Learning Outcomes

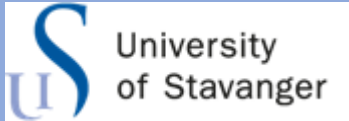




Game Elements

Adopting the elements of board game





The Game Story & Objectives

Two companies, ABX Engineering Inc. and ZYC Engineering Inc. provide integrity management service for oil and gas industry. An oil and gas company, DCK Exploration & Production (E&P), intends to hire one of these companies to conduct Risk-Based Inspection (RBI) analysis for all of their offshore platforms. To decide which company to hire, DCK E&P gives both of them a pilot project, which involves one of their offshore platforms. The company that finishes the project first will be selected.





The Game Story & Objectives



vs



ABX Engineering Inc.
Understand the importance of
managing WIP

ZYC Engineering Inc.
Batching the process is the
way they do the work





The Board

We have two boards: one for regular work, the other for rework

Drawings Development (DD) WIP Limit _____		Damage Mechanism Assessment (DM) WIP Limit _____		Software Input and Analysis (SA) WIP Limit _____		Client Review No WIP Limit	Accepted No WIP Limit
In Progress	Complete	In Progress	Complete	In Progress	Complete		



The Cards

Unit 6: Gas Treatment		First Review: Second Review:
DD	○○○○○	▽▽▽
DM	○○○○○	▽▽▽
SA	○○○○○	▽▽▽
Week Accepted	Week Start	Lead Time
-	=	

Normal Work (arrow pointing to the top right of the table)

Rework (arrow pointing to the top right of the table)

Due to incomplete data and information, some assumptions must be made by the team. The team leader instructs all the members to list and record all the assumptions made. The color on the heading of each unit represents the basis of assumptions. Units with the same color have the same assumptions.

No action needed

Event Card 1

○ Unit Cards

- Each unit card has a number of white dots which represent the work required to complete the unit.
- The reversed triangles represent the work required to do rework, if necessary
- The dots are arranged in three sections, representing Drawings Development (DD), Damage Mechanism Assessment (DM), and Software Input & Analysis (SA)

○ Event Cards

- Event card is picked according to the listed instruction.
- The action listed in the card shall be carried out by the players.





The Unit Cards: Types

Unit 6: Gas Treatment		First Review: Second Review:
DD	OOOOO	▽▽▽
DM	OOOOO	▽▽▽
SA	OOOOO	▽▽▽
Week Accepted	Week Start	Lead Time
-		=

Hydrocarbon Units

Indicated by red cards. These unit cards have a high priority to be completed first.

Unit 8: Water Injection		First Review: Second Review:
DD	OOOO	▽▽
DM	OOOO	▽▽
SA	OOOO	▽▽
Week Accepted	Week Start	Lead Time
-		=

Flare, Drain, & Utilities Units

Indicated by yellow cards. These unit cards have a medium priority.

Unit 14: Methanol Injection		First Review: Second Review:
DD	OOO	▽
DM	OOO	▽
SA	OOO	▽
Week Accepted	Week Start	Lead Time
-		=

Chemical Injection & Air System

Indicated by green cards. These unit cards have a low priority.



The Unit Cards: Lead Time

Unit 6: Gas Treatment		First Review: 5 Second Review:
DD	000000	▽▽▽
DM	000000	▽▽▽
SA	000000	▽▽▽
Week Accepted	Week Start	Lead Time
6	- 1	= 5

We will use the three leftmost fields at the bottom of each unit to calculate Lead Time.

Lead Time is the number of weeks it takes for a card to travel across the board from Start to Accepted.

For each unit, we record the week it was started and the week it was accepted by the client.

Then we can calculate Lead Time:
 $Week\ Accepted - Week\ Start = Lead\ Time.$

We also need to record the week of which the unit being reviewed at the upper right corner of the card.





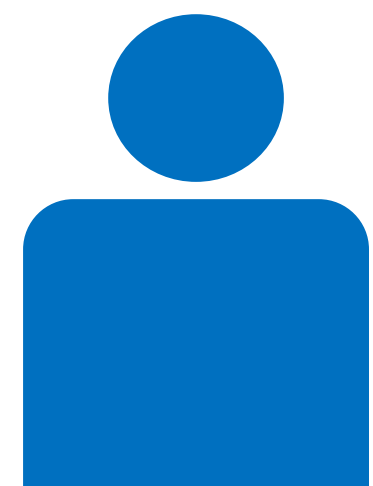
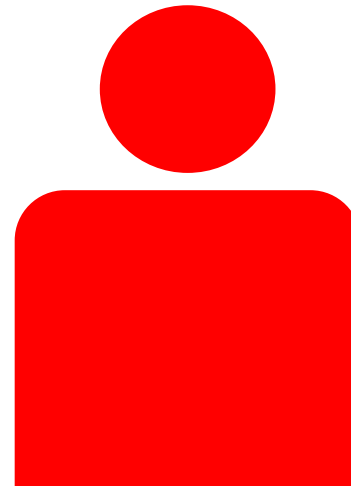
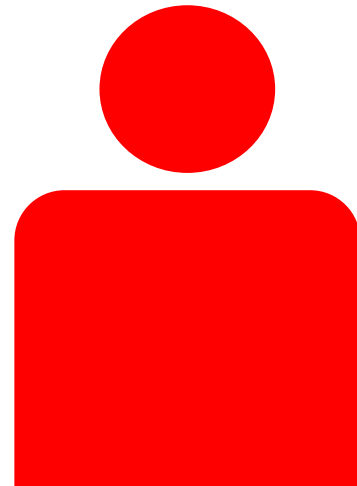
The Unit Cards: Rules

- Unit cards may be selected from the Unit Cards Stack according to the priority order.
- Unit Cards may be pulled across the board in any order.
- The selected column must be filled to its WIP limit every week. If it is not possible to fill every column, the column with more upstream location is prioritized to be filled first.
- Unit cards may be moved downstream (as long as WIP limits are not exceeded) in order to make room upstream to pull tickets.



The Dice

- The dice represents engineers in our team. The colours indicate their specialization.
- A red dice represents a corrosion/material engineer while the blue dice represents an RBI engineer.
- An RBI engineer can do the task in all three steps (i.e. Drawings Development, Damage Mechanism Assessment, and Software Input and Analysis), while a corrosion/material engineer can only do Drawings Development and Damage Mechanism Assessment tasks.

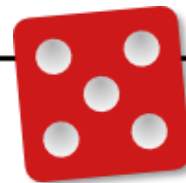




The Dice

Unit 6: Gas Treatment		First Review: Second Review:
DD	00000	▽▽▽
DM	00000	▽▽▽
SA	00000	▽▽▽

Week Accepted - Week Start = Lead Time

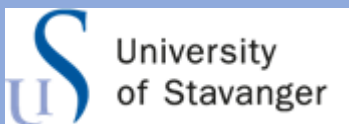


Some Rules

All dice must be assigned before any dice are thrown.

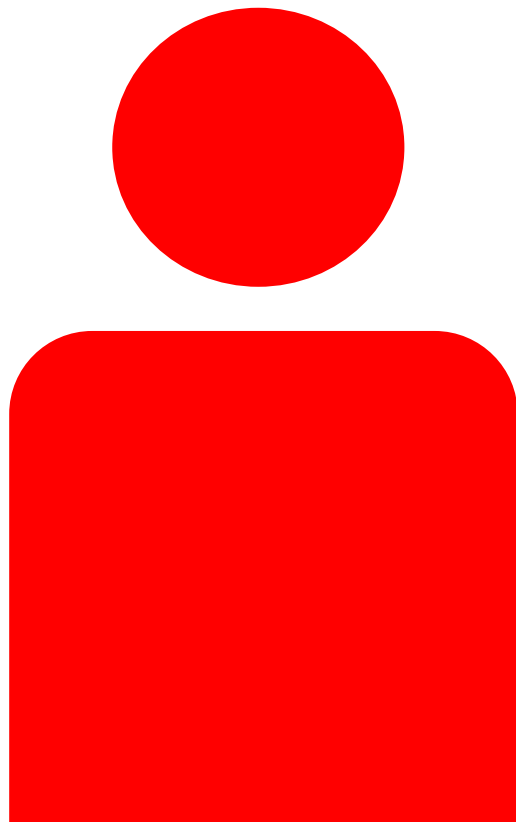
Once assigned, dice may be thrown and work struck off in any order.

Multiple dice could not be assigned to a single unit. Any leftover points must be spent in the same specialization that the dice was originally thrown for.



The Players

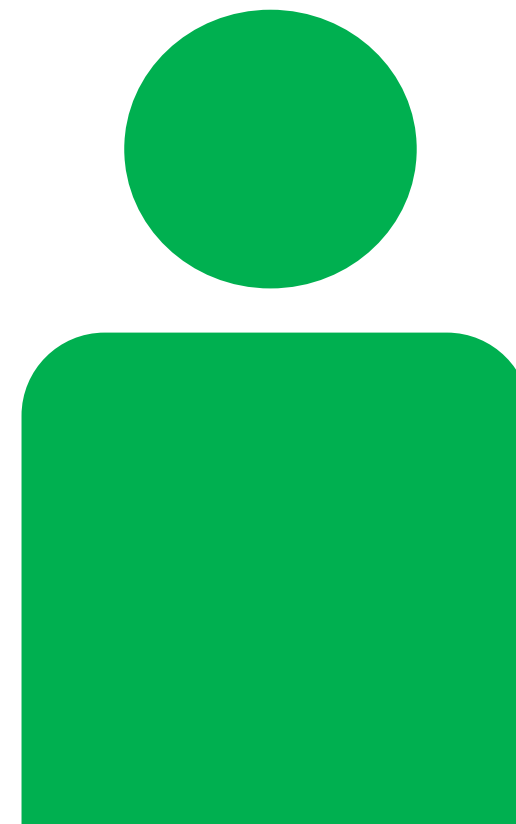
Three participants in a team, each with a specific job description



Project Manager



Resource Tracker



Work Tracker





Project Manager

Responsible for the weekly steps

05. Week Complete/End of Day

Pick up end of the week event card (if there is any). Read aloud, action if necessary, and place the event card back at the deck. See a plan for the event card section for pick up scheduling.

04. Track Charts

The project manager ensures that the chart tracker updates their charts. Trackers complete charts: CFD at the end of every week; control the chart only if certain units have been accepted.

01. Group Meeting

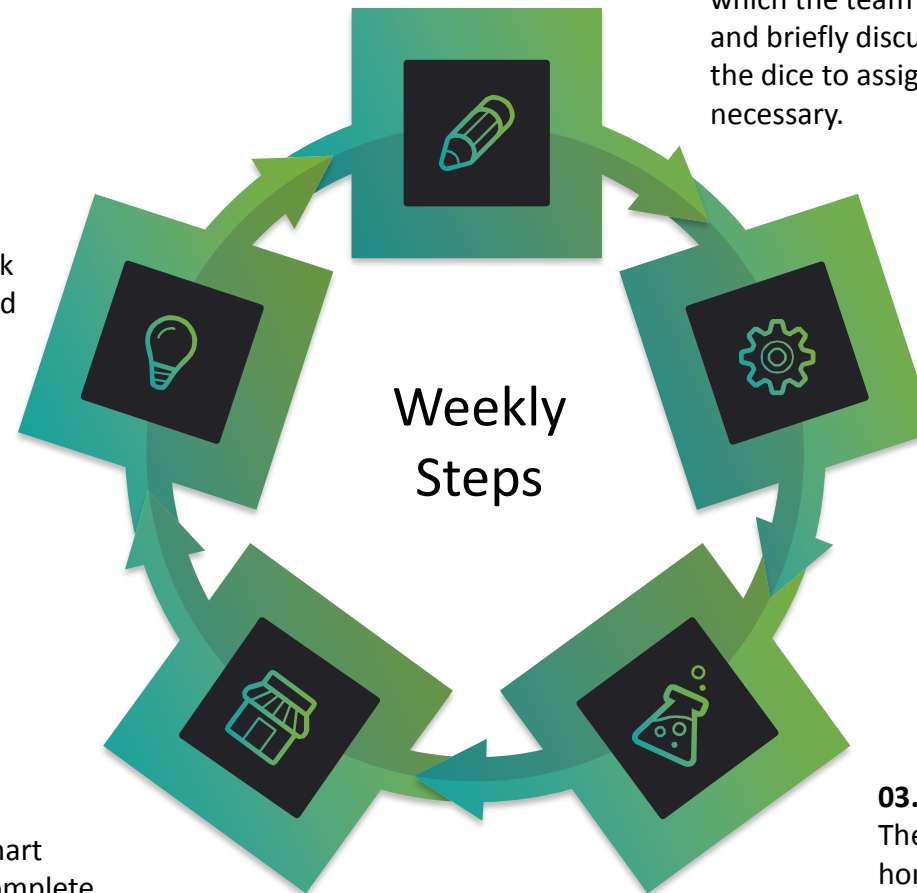
The project manager facilitates a “group meeting” during which the team observe the state of the work on the board, and briefly discuss the strategy for the day. The team decide the dice to assign for each unit and the units to pull if necessary.

02. Play Board

Throw the dice, reduce work on assign units by the face value the dice shows, take notes of any leftover work. Spend leftover work on other units, pull units to do so if necessary (ensure WIP limits are honored). Repeat until all dice have been thrown for the week. Track the available time (i.e. the face value shown by the dice) and the used time (i.e. the face value used to reduce the work on the assign unit) on the Resource Utilization Chart.

03. Sanity Check

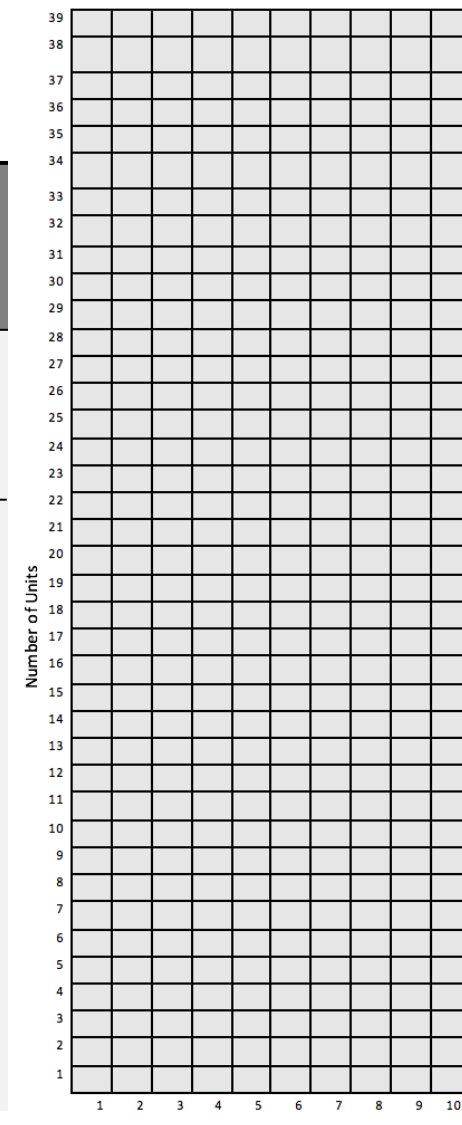
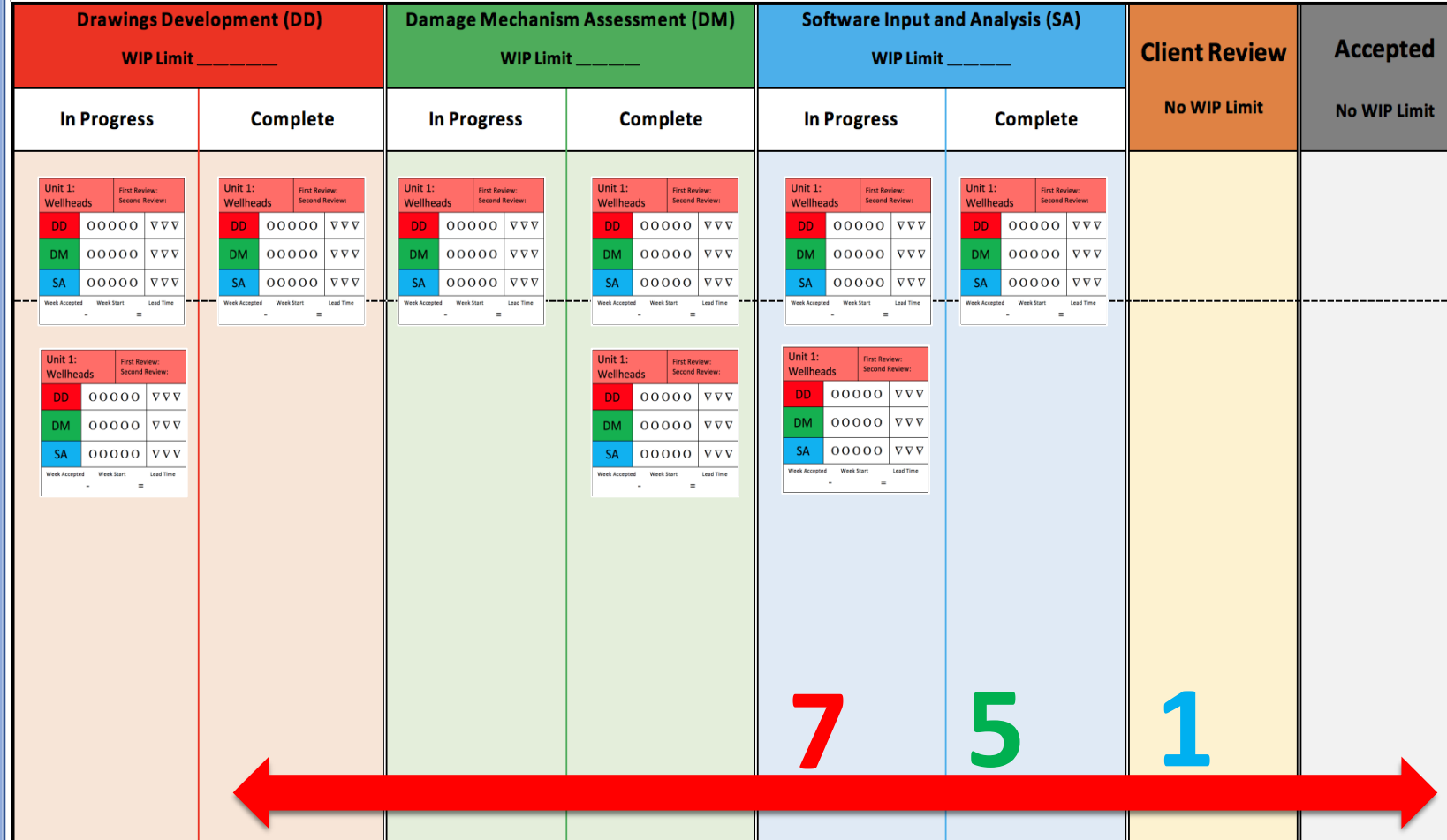
The project manager ensures WIP limits are honoured, and all unit cards are up to date: the week ready field is complete on all unit cards pulled into the board; the week accepted and lead time field is complete on all accepted cards.





The Cumulative Flow Diagram

For instance, this is the condition of the board at week 1



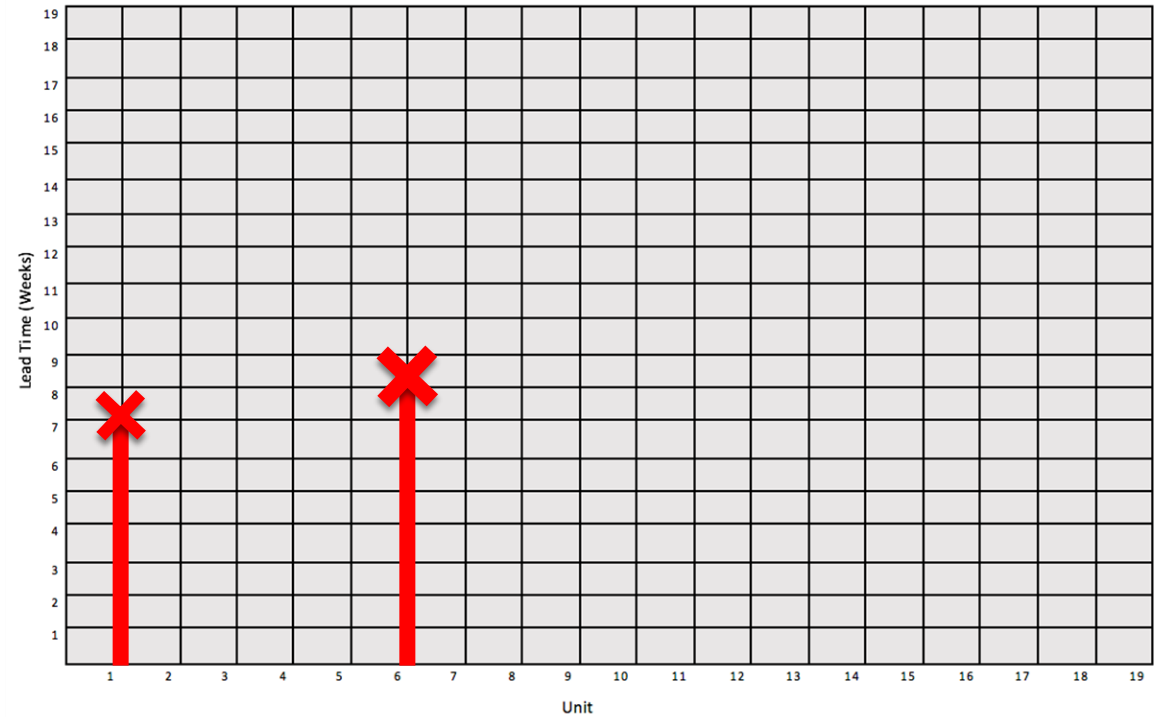
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The Control Chart

Unit 1: Wellheads		First Review:
		Second Review:
DD	OOOOO	▽▽▽
DM	OOOOO	▽▽▽
SA	OOOOO	▽▽▽
Unit 6: Gas Treatment		First Review:
		Second Review:
DD	OOOOO	▽▽▽
DM	OOOOO	▽▽▽
SA	OOOOO	▽▽▽
Week Accepted	Week Start	Lead Time
13	- 5	= 8



Control Chart



The Resource Utilization Chart



Unit 1: Wellheads	First Review: Second Review:
DD	OOOOO ▽▽▽
DM	OOOOO ▽▽▽
SA	OOOOO ▽▽▽
Week Accepted	Week Start Lead Time
-	=

Unit 8: Water Injection	First Review: Second Review:
DD	OOOO ▽▽
DM	OOOO ▽▽
SA	OOOO ▽▽
Week Accepted	Week Start Lead Time
-	=

Unit 14: Methanol Injection	First Review: Second Review:
DD	OOO ▽
DM	OOO ▽
SA	OOO ▽
Week Accepted	Week Start Lead Time
-	=



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Week	Engineer 1		Engineer 2	
	Available Time	Used Time	Available Time	Used Time
1	5	5	4	4





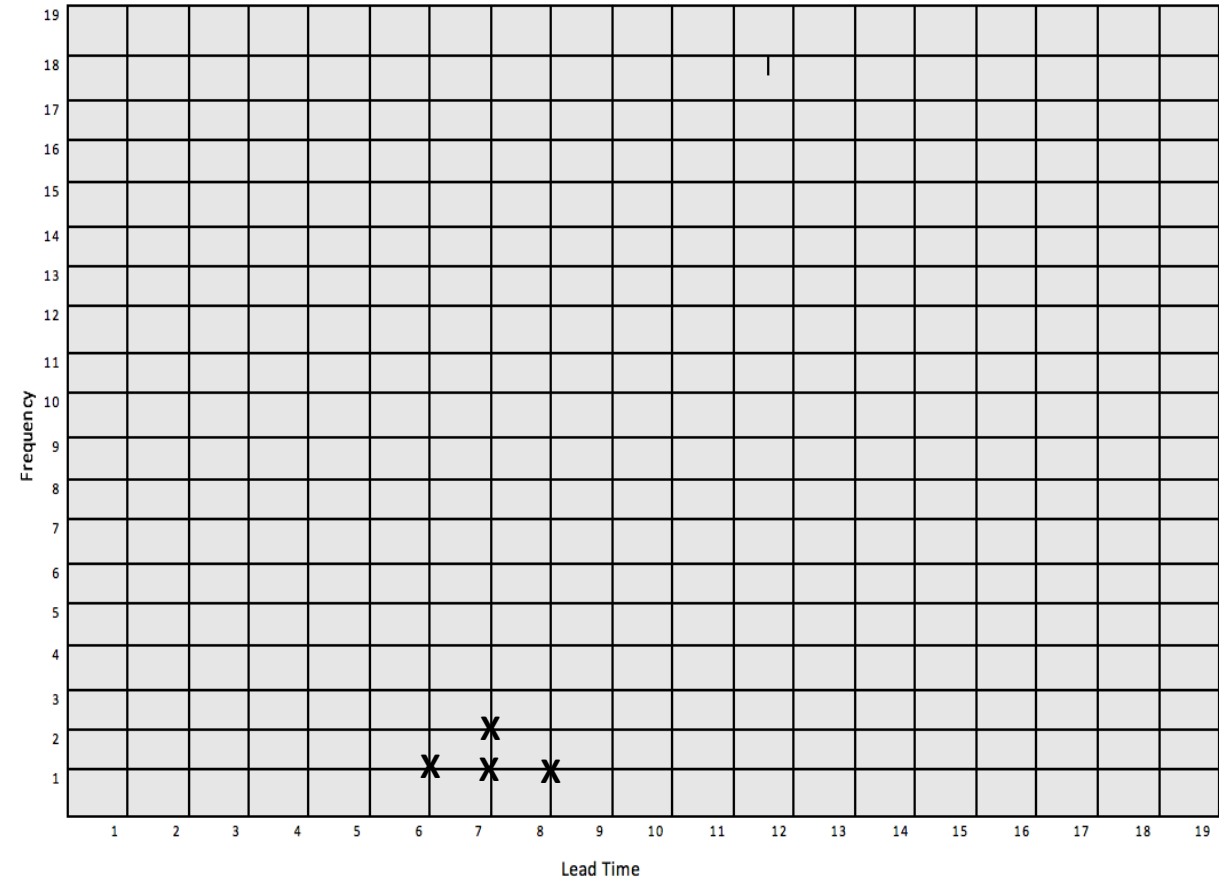
Lead Time Distribution Chart

Unit 1: Wellheads		First Review: Second Review:	
DD	00000	▽▽▽	
DM	00000	▽▽▽	
SA	00000	▽▽▽	
Week Accepted	Week Start	Lead Time	
-	=		

Unit 1: Wellheads		First Review: Second Review:	
DD	00000	▽▽▽	
DM	00000	▽▽▽	
SA	00000	▽▽▽	
Week Accepted	Week Start	Lead Time	
-	=		

Unit 1: Wellheads		First Review: Second Review:	
DD	00000	▽▽▽	
DM	00000	▽▽▽	
SA	00000	▽▽▽	
Week Accepted	Week Start	Lead Time	
-	=		

Unit 1: Wellheads		First Review: Second Review:	
DD	00000	▽▽▽	
DM	00000	▽▽▽	
SA	00000	▽▽▽	
Week Accepted	Week Start	Lead Time	
-	=		



Lead Time Distribution Chart





LET'S PLAY!

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