

# **GAMIFICATION OF INDIVIDUAL MARKSMANSHIP TRAINING: TOWARDS MARKSMAN COMPETENCY AND SAFETY**

**Adele Lim Yu Qing<sup>1</sup>, Chin Jen Bin<sup>2</sup>, Goh Ze Li<sup>3</sup>**

<sup>1</sup> Raffles Girls' School (Secondary), 2 Braddell Rise, Singapore 318871

<sup>2</sup> Catholic High School, 9 Bishan Street 22, Singapore 579767

<sup>3</sup> Defence Science and Technology Agency, 1 Depot Road, Singapore 109679

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## **ABSTRACT**

In recent years, gamification has received the spotlight as a possible solution to help make training more effective and it is not without reason. Video games have been designed to be as engaging as possible, and analysing embedded gamification mechanisms can grant an insight into how one may further engage users. In this paper, the MINDEF's Individual Marksmanship Trainer (IMT) is examined by identifying the various touchpoints and raising possible future implementations to enhance the current user journey. Design Innovation (DI) techniques were utilised to help analyse users' needs and identify opportunities for improvement. These possible future implementations were designed using gamification principles in mind to help create a more engaging and effective IMT.

## **1 INTRODUCTION**

MINDEF's Individual Marksmanship Trainer (IMT) is a conduct that every trainee has to go through before they can qualify for the live firing exercise. Providing recruits with a simulated version of live firing, IMT allows recruits to familiarise themselves with weapon handling and commands in a safer and less costly environment before live firing. Trainers on the ground will assist and correct trainees' shooting fundamentals if necessary. While today's IMT enables rehearsal of weapon and safety fundamentals prior to live firing, there remains opportunities to make training more engaging and for learning outcomes to be better sustained.

In the realm of engagement and learning, gamification has been proven to be especially beneficial in strengthening motivation and engagement levels in learners [1]. Gamification is defined as "the craft of deriving fun and engaging elements found typically in games and thoughtfully applying them to real-world or productive activities" [2]. Research has shown that game techniques implemented within the learning process, as activities whose purpose is to achieve certain learning objectives, increase learners' motivation to complete them and engage learners in a friendly competitive environment. This thereby creates conditions for an effective learning process [3].

As such, this project aims to apply gamification principles, techniques and methods to the training process of IMT in order to enhance training experience, strengthening the trainees' motivation, ultimately increasing the effectiveness of IMT as a training tool. By employing design innovation (DI) and analysing gamification core drives, the opportunities for IMT trainees can be identified and analysed to better formulate modifications to existing workflows. This would improve the overall experience and consequently effectiveness of IMT, equipping trainees with the necessary skills for live firing, the next stage of shooting training.

## 2 RESEARCH

### 2.1 Gamification

Utilising core principles of gamification and placing the user at the centre of the development process enable solutions to be tailored towards human feeling, drives and engagement [2]. Gamification allows users to remain motivated for longer periods of time, maximising the effectiveness of training. Therefore, it is vital that the users' needs and desires are understood through a gamified lens to properly identify key issues with the current system, as well as room for improvement upon which gamified elements may be introduced.

A thorough research and analysis on the principles behind the application of gamification was conducted. Yu-Kai Chou's Octalysis framework defines a set of eight fundamental motivators of behaviour (core drives), which influence human activities. These eight core drives are: (1) Epic Meaning, (2) Accomplishment, (3) Empowerment, (4) Social Influence, (5) Ownership, (6) Unpredictability, (7) Scarcity, and (8) Avoidance (see Appendix A, Figure A1) [2]. Each core drive taps on different mechanisms and techniques, as summarised in Table 2.1 [2].

Table 2.1: Core Drives, Mechanism and Techniques

	<b>Core Drive</b>	<b>Description</b>	<b>Motivation</b>	<b>Technique Examples</b>
1	Epic Meaning & Calling	Driven by the belief that they are engaged in something bigger than themselves	Extrinsic & Intrinsic	Contributing on Wikipedia without pay due to the belief that they are contributing to humanity
2	Development & Accomplishment	The internal drive of making progress, developing skills, and overcoming challenges	Extrinsic	Status Points, Badges, Leaderboards
3	Empowerment of Creativity & Feedback	Users' creativity are challenged while receiving instant feedback for the results of their creativity	Intrinsic	Boosters, Milestones Unlocked
4	Ownership & Possession	Users are motivated because they feel like they own something; users will hence innately want more or to have a better status	Extrinsic	Exchangeable Points (most membership and payment apps use this to retain users), Avatar
5	Social Influence & Relatedness	This core drive involves activities motivated by what others think, do, or say; e.g. when people see those they know owning an item, they too will desire it	Intrinsic	Water Cooler, Group Quests, Mentorship
6	Scarcity & Impatience	The drive of wanting something because you cannot have it	Extrinsic	Dangling, Price Pacing

7	Unpredictability and Curiosity	The drive of wanting to know the unknown and explore it	Intrinsic	MiniQuests, Easter Eggs, Sudden Rewards
8	Loss and Avoidance	This drive motivates people through the fear of losing something or having negative events occur	Extrinsic & Intrinsic	Progress Loss, Sunk Cost Prison

## **2.2 Extrinsic Motivations**

Extrinsic motivation is motivation derived from an external source, be it through incentives or punishments. Research has shown that most current gamified systems rely on providing some form of reward for activities carried out by the player [4]. These systems use all the common game mechanics such as badges, levels and leaderboards, achievements and points (BLAP) [5]. These elements act mainly on extrinsic motivations, and are closely related to the core drive of Development and Accomplishment.

## **2.3 Self Determination Theory**

To be effective on a long-term basis, gamification must also act on the intrinsic motivation of the players, whereby a person is internally motivated to complete a task. Gamification, in its quest to generate a game-like level of engagement in non-gaming contexts, must create a meaningful experience and not only rely on commonplace extrinsic rewards [5].

Self-Determination theory (SDT) is a theory that pertains to the motivation behind people's actions in the absence of external influence [6]. SDT focuses on the core drives such as “empowerment of creativity and feedback” and “social influence and relatedness”. SDT proposes three factors that need to be fulfilled for intrinsic motivation: (i) Autonomy, the idea of having freedom over your choice and decision; (ii) Competence, the task being of similar skill level to the individual increasing likelihood of action; and (iii) Relatedness, the desire to interact with those around us [7]. By considering these three motivators, intrinsic motivation can be maximised.

## **2.4 Flow Theory**

In order to be intrinsically motivated to perform a task, a person must be kept in a state between anxiety and boredom, also known as a state of flow [8]. Flow is a consciousness state experienced by individuals when their activities are fully immersed in a feeling of energised focus and deep involvement and enjoyment [9]. Studies [10], [11] also show that flow has had a positive influence on learning behaviour and performance.

Flow theory proposes that there are three conditions to be met to achieve state of flow [5]: (i) being involved in activities with clear and structured goals and progress; (ii) performing tasks with articulate and immediate feedback; and (iii) having a good balance between the perceived challenge level and skill level. Intrinsic motivation can be maximised by considering these factors.

### 3 MATERIALS AND METHODS

The Design Innovation (DI) framework (see Appendix B, Table B1) is a human-centred and interdisciplinary approach to empathise with stakeholders, uncover latent needs and innovate solutions to address complex challenges. There is value in synergising both user-focused concepts of DI and gamification, in order to identify and address opportunities in IMT today. Figure 3.1 illustrates the flow of DI methods adopted throughout the project.

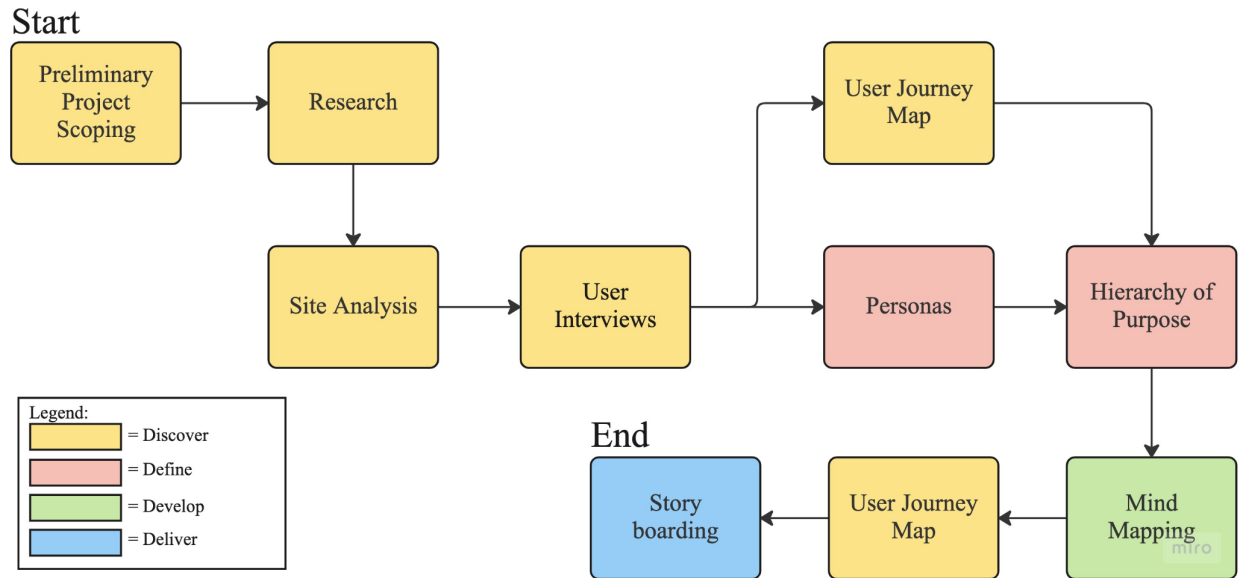


Figure 3.1: DI Method Flow Chart

#### 3.1 Discover Phase

##### 3.1.1 IMT Visitation

Using prior knowledge of IMT's programme from preliminary research and training directives, the more IMT-relevant core drives were identified to be: Accomplishment, Empowerment and Social Influence. With these main core drives in mind, a list of questions were devised to be asked and observed during the IMT visitation.

##### 3.1.2 Interviews with Users

Interviews were also conducted with users to obtain a broader understanding of IMT and potential opportunities from different personas' experiences. The findings from both the IMT visitation and interviews were used to create the IMT User Journey Map.

##### 3.1.3 User Journey Map

In order to understand IMT users' touchpoints, thoughts and emotions in their IMT user experience, a user journey map was created. This enabled the identification of insights and opportunities for the enhancement of IMT using gamification.

## **3.2 Define Phase**

### **3.2.1 Questionnaires for Users**

To define the problem statement by gaining a better understanding of the perceived current state and perceived resultant state of this project, questionnaires were given to users to evaluate the current IMT experience as well as identify opportunities and ideal conditions that would create a better IMT experience.

### **3.2.2 Hierarchy of Purpose**

After the Discover phase, using the user journey map and findings from the interview, the Hierarchy of Purpose was used to reframe and scope the problem statement, thereby bringing root causes and underlying issues clearly into consideration. By scoping the problem statement into the “How might we...” format, the core issues were surfaced.

## **3.3 Develop Phase**

### **3.3.1 Mind Mapping**

The Mind Mapping method was used to brainstorm various ideas with respect to the problem statement. From the two key opportunities identified, namely Marksmanship Competency and Safety, the mindmap branches into three subcategories, which were the identified gamification core drives of Accomplishment, Empowerment and Social. From there, multiple ideas, along with their corresponding impact, were generated and prioritised.

## **3.4 Deliver Phase**

### **3.4.1 Revamped User Journey Map**

A revamped user journey map was created to depict the complete timeline of the user experience with the implementation of the devised ideas.

### **3.4.2 Storyboarding**

By storyboarding, the actions and interactions of trainees at various touchpoints across time were illustrated, simulating the scenarios where ideated gamification elements are introduced to the system. This visualisation enabled better verification of the effectiveness of the ideas developed in the Develop Phase. Storyboarded ideas were pitched to IMT users, who gave feedback and comments on the relevance of the ideas, further enhancing ideas. The final solutions for enhancing IMT experience were derived from the most relevant and effective ideas.

## **4 RESULTS**

### **4.1 User Journey Map**

Based on site analysis and user interview findings, a user journey map was created (see Appendix C). The User Journey Map provides a clear and comprehensive visual depiction of the complete timeline of the trainees’ experience when using IMT. As a result, the key areas for enhancements are easily identified for ideation. Significant opportunities are summarised in Table 4.1.

### **4.2 Hierarchy of Purpose**

The Hierarchy of Purpose for this project’s problem statement is shown in Table 4.1. It can be seen that the underlying needs are increasing marksmanship competency and ensuring strong safety fundamentals, while keeping IMT engaging. As gamification is vital in achieving high

levels of engagement and learning by (i) directly addressing users' core needs and desires, and (ii) providing extrinsic and intrinsic motivation for users; it would be valuable to explore how gamification can enhance the effectiveness and engagement of IMT.

Table 4.1: Hierarchy of Purpose

Hierarchy of Purpose	Opportunity/ Problem Statement
<b>Original</b>	How might we enhance the effectiveness and engagement of IMT as a training tool?
<b>General (Why?)</b>	How might we enhance trainees' soldier fundamentals (marksmanship competency, safety)? How might we enhance motivation and knowledge retention among trainees?
<b>Specific (How?)</b>	How might we utilise IMT to increase the percentage of marksmen while keeping it engaging? How might we equip trainees with strong safety fundamentals of weapon handling (100% safe practices)?

## 5 DISCUSSION

### 5.1 Mind Mapping

As seen in the mindmap (see Appendix D, Figures D1 and D2), it was ensured that the ideated solutions directly tackle marksmanship competency and safety of trainees, while addressing the maintenance of high engagement levels of IMT, as solutions were ideated in close accordance to the three gamification core drives of Accomplishment, Empowerment and Social. The most impactful solutions were then incorporated into the revamped user journey map.

### 5.2 Revamped User Journey Map

The revamped user journey map (see Appendix E) showcases the IMT user experience enhanced with gamification elements. It reflects the envisaged resultant timeline of the IMT trainee experience after the implementation of solutions proposed. The most impactful solutions and the opportunities they address respectively are summarised in Table 5.1.

### 5.3 Storyboard

To communicate the enhanced IMT journey and solicit further feedback from users, a storyboard was created to visually illustrate the envisaged resultant timeline. The storyboard was presented to users and feedback obtained on the revamped user journey was affirmative. The Storyboard for the relevant ideas, categorised into the Before Activity, During Activity, and Post-Activity sequences, are presented in Figure 5.2, 5.3, and 5.4 respectively. A legend for the storyboard is shown in Figure 5.1, with each colour representing a core drive in play during a particular segment of the envisaged IMT journey.

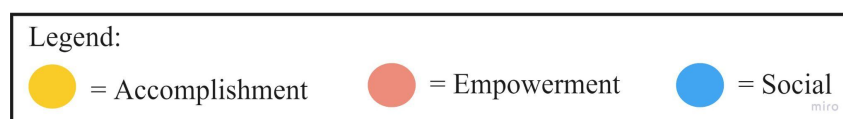


Figure 5.1: Legend for Storyboard



Figure 5.2: Storyboard for Before Activity (Briefing)

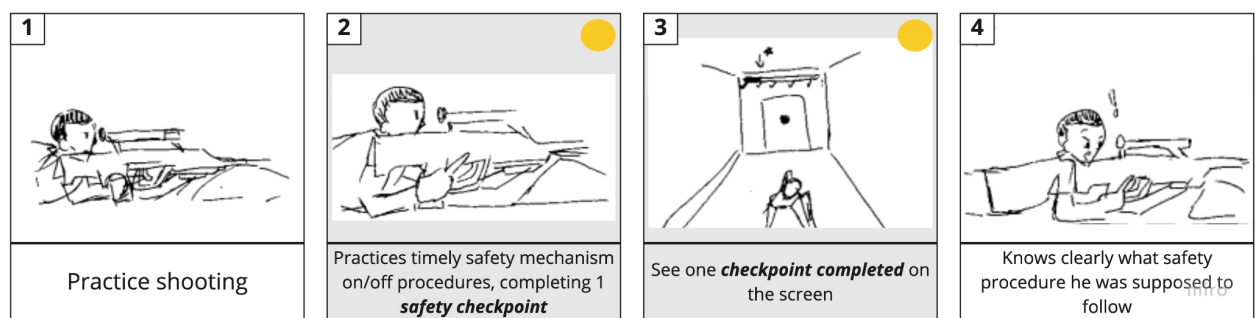
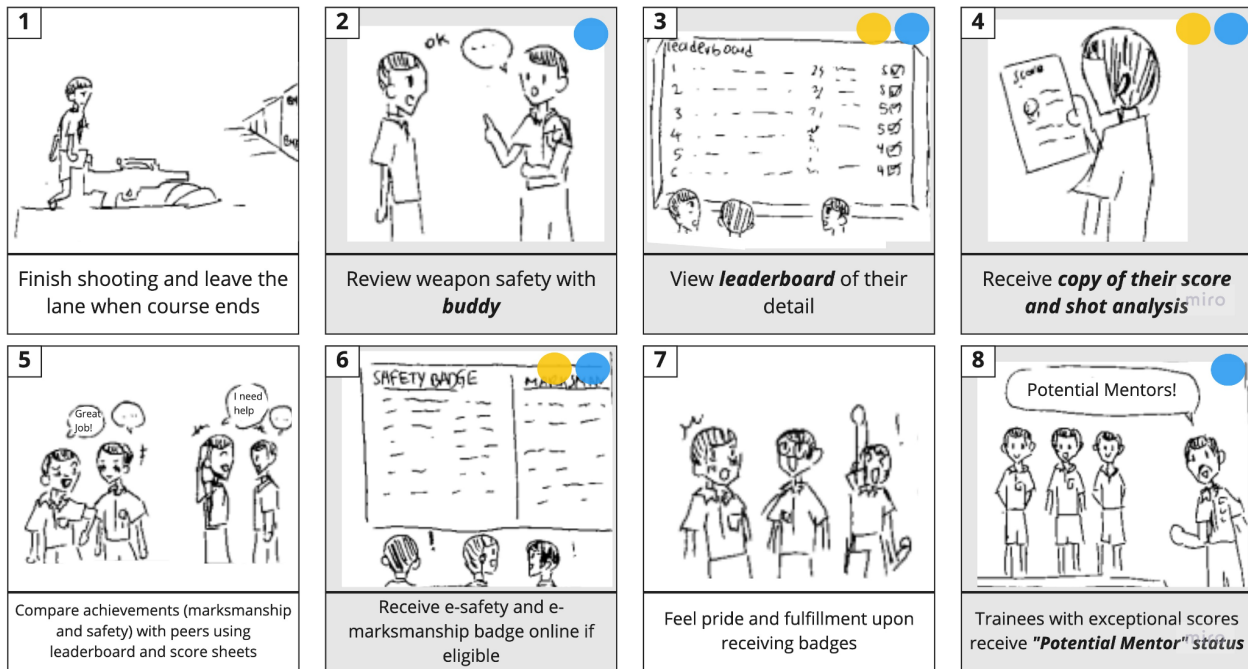
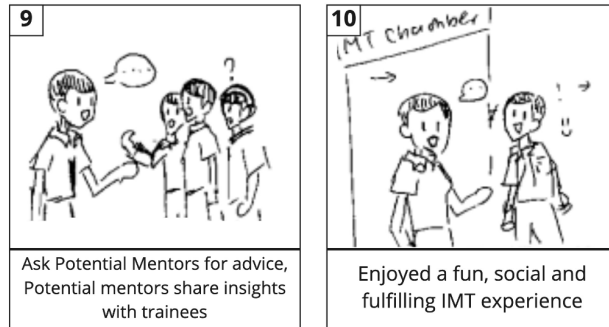




Figure 5.3: Storyboard for During Activity (Shooting)







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Figure 5.4: Storyboard for Post-Activity (Review)

The proposed solutions and the respective opportunities addressed are summarised in Table 5.1.

Table 5.1: Proposed Solutions

Opportunities	Solutions	Core Drive
Pre-shoot briefing	Consolidated bite-sized learning material and tips on weapon handling/safety in trainees' phone	Empowerment/ Social
Interest or excitement for IMT	Buddy system to help observe current training detail to spot subconscious mistakes	Social
Guidance and enforcement of safety drills within IMT	Safety Progress Bar, whereby trainees can see their progress on the set of safety requirements they need to fulfil	Accomplishment
	E-safety badge for trainees who complete their safety progress bar	Accomplishment
Shot analysis presentation	Shot information is easily presented (after each stage) so that trainees can adjust accordingly prior to next stage	Empowerment
Feedback on how to improve		
Level of engagement for observing detail	Leaderboard that updates trainees' results and ranking within detail in real time	Social/ Accomplishment
Clearly determine level of achievement		
	Trainees can receive a copy of their score and shot analysis	Accomplishment/ Social

	E-Safety and E-Marksmanship badge for excellence in practising safety and marksmanship; names of awardees will be displayed on screen	Accomplishment/ Social
Social and collaborative learning	Trainees that excel in marksmanship can receive the “Potential Mentor” status, who fellow trainees can approach for advice	Social

## 6 CONCLUSION AND FUTURE WORK

To conclude, the research process helped highlight the importance of motivation in training, and gamification as a powerful tool in increasing users’ engagement and motivation, both intrinsic and extrinsic. By fusing both user centric approaches of DI and gamification, suitable opportunities that exist within IMT today were targeted, and revamped workflows with gamification elements were proposed. At an individual level, the learning and feedback mechanisms present users with a much clearer indication of their performance, thereby driving their motivation and engagement. At a detail and cohort level, users experience a collaborative and social learning environment in which a sense of camaraderie is fostered, enabling users to progress in their marksmanship and safety competency as a whole, allowing learning to be sustained. Overall, a more holistic and effective IMT is realised.

As part of future work, it would be possible to further tackle two factors from SDT, namely autonomy and competence, as well as the third requirement of achieving the state of flow, namely balancing between perceived challenge and skill levels. This would be beneficial in maximising knowledge obtained from IMT by ensuring the user is constantly in a state of flow. It might be valuable to explore allowing trainees to experience a degree of autonomy and challenge, further driving intrinsic motivation and allowing them to reinforce knowledge learnt from their shot analysis for continual improvement. In addition, it would also be valuable to analyse opportunities present in the user journey of trainers within IMT, as trainers play a pivotal role in trainees’ marksmanship and safety competency by providing appropriate feedback and guidance. By capitalising on these opportunities, the effectiveness of IMT can be further improved.

## 7 ACKNOWLEDGEMENTS

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## APPENDIX

### Appendix A

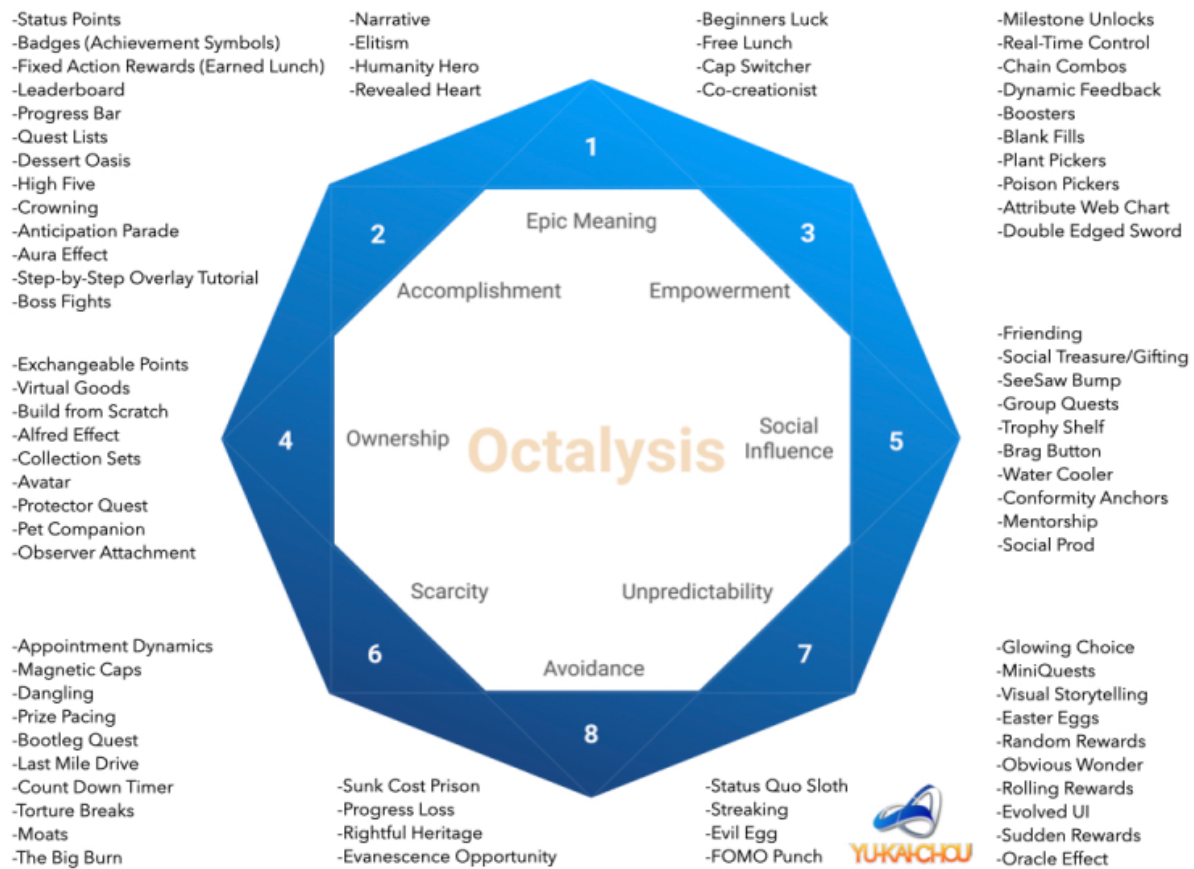


Figure A1: Yu-Kai Chou Octalysis Framework

## **Appendix B**

Table B1: DI Phases

<b>Phases of DI</b>	<b>DISCOVER</b>	<b>DEFINE</b>	<b>DEVELOP</b>	<b>DELIVER</b>
Key Mindsets	Empathy	Mindfulness	Joy	Non-attachment
Broad Objectives	Understand the system (e.g. organisation) of interest, its intricacies and its stakeholders. Uncover latent needs and new opportunities.	Identify the right problem. Articulate the desired outcome without prescribing the solution.	Generate a variety of ideas to achieve the desired outcome. Prioritise the ideas for further development with stakeholders.	Derive the solution via interactive and iterative communication and tests with stakeholders on the ideas.

## Appendix C

Figure C1 shows the user journey map, where the touchpoint and decisions are presented in the first row, with the respective channels in the second row. Insights and opportunities for ideation are presented in the third row. An emotional level sketch is presented in the fourth row, in which the horizontal axis depicts a neutral emotional state. The ups and downs faced by the users are plotted, whereby a point located above the horizontal axis represents positive emotions (i.e. positive user experiences).

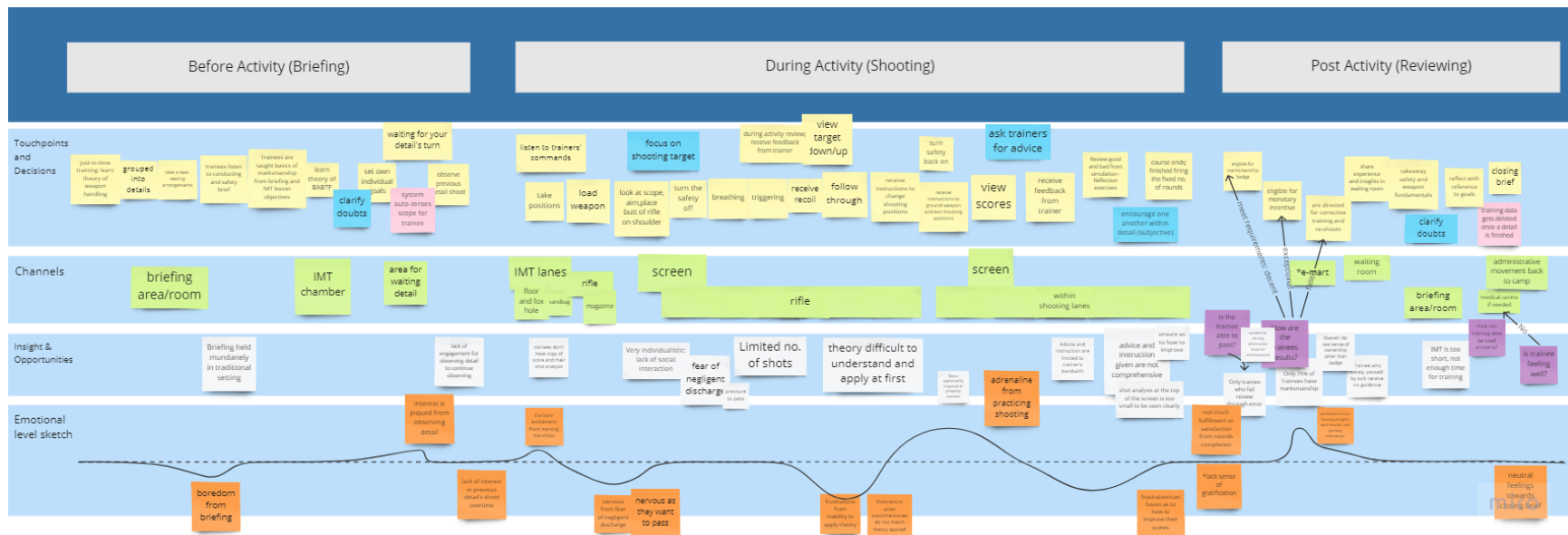


Figure C1: User Journey Map

## Appendix D

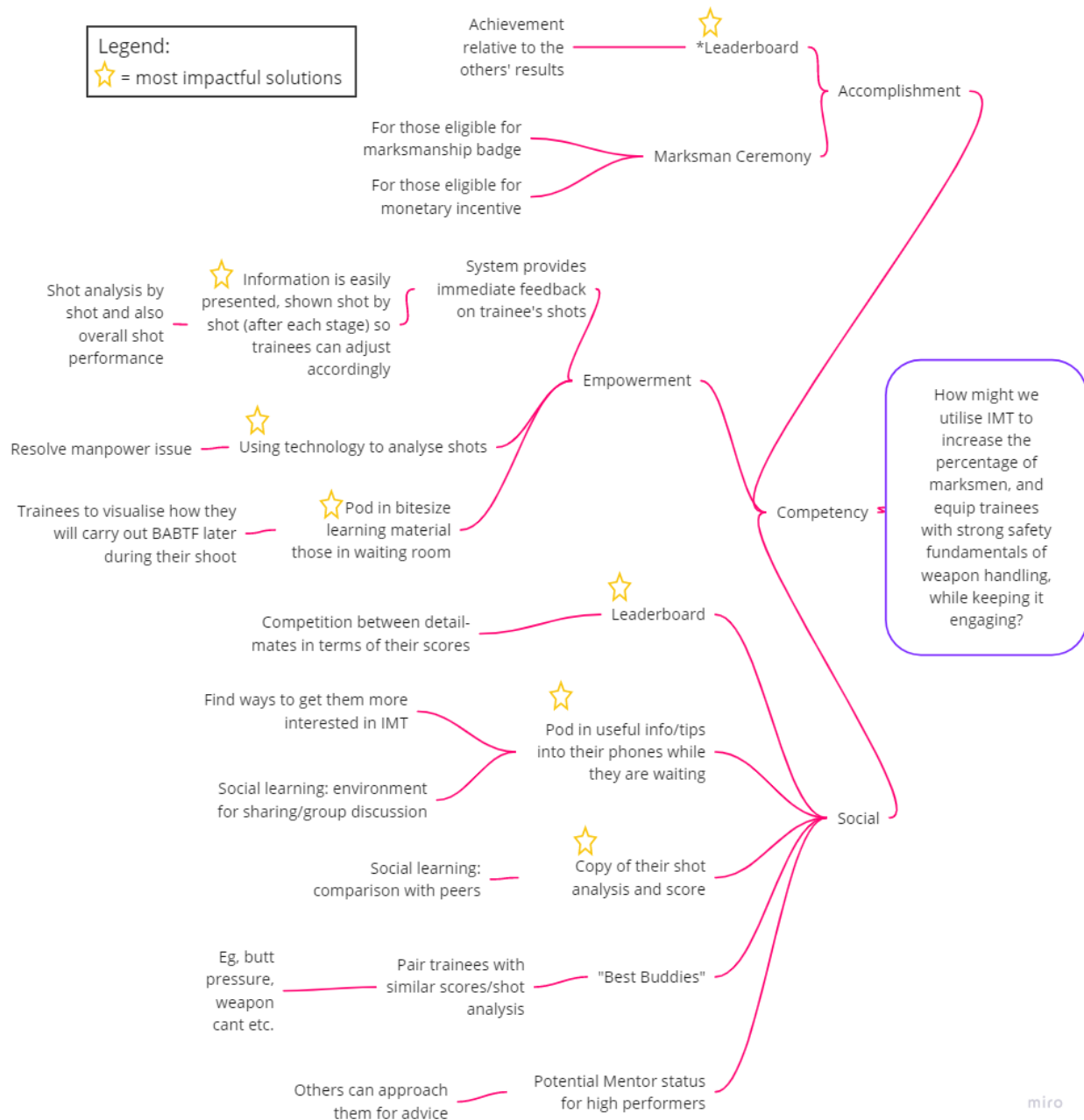
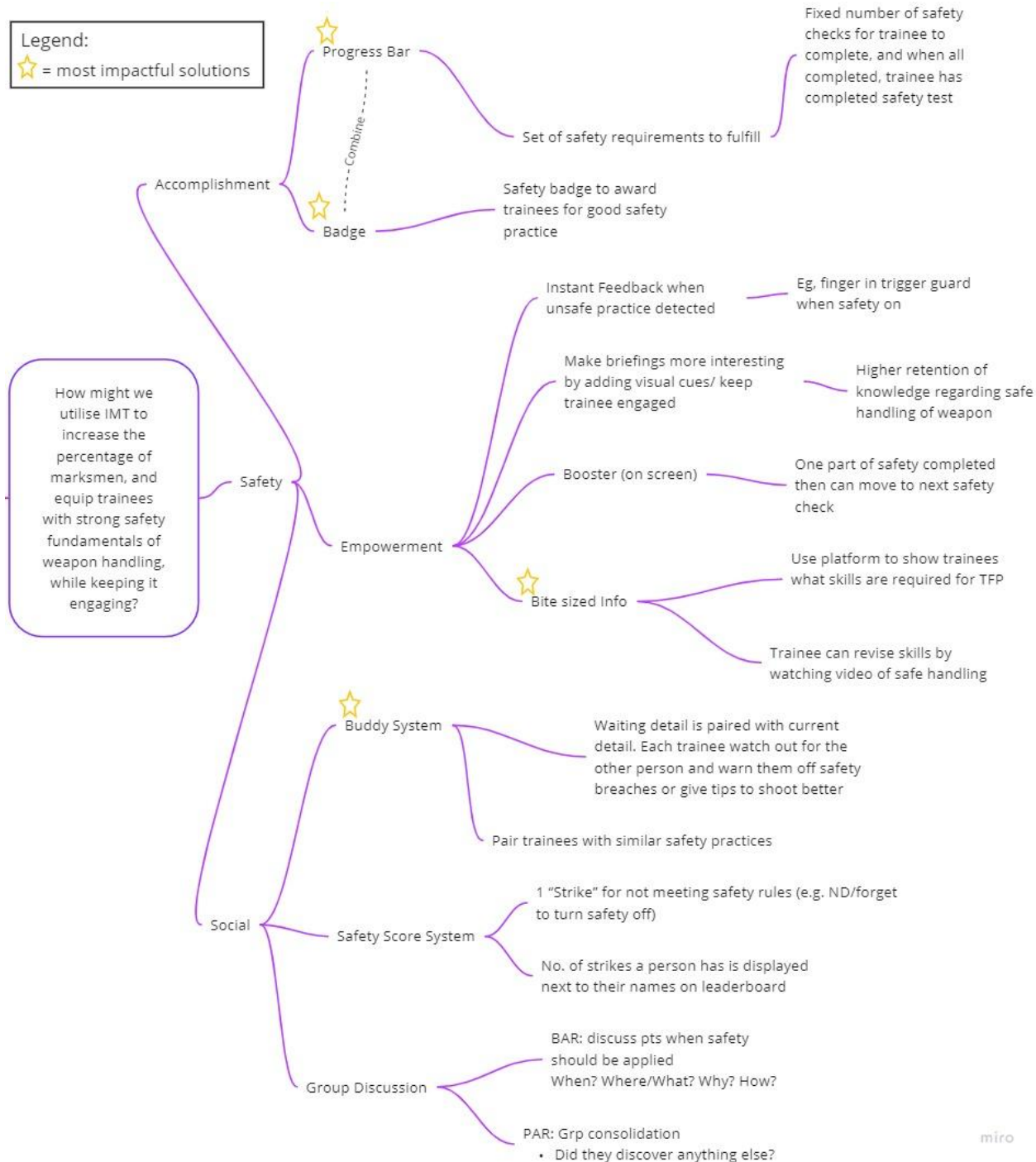


Figure D1: Mindmap of Ideas (Marksmanship Competency)



**Figure D2: Mindmap of Ideas (Safety Competency)**



## 17

Figure E1 shows the revamped user journey map enhanced with ideated solutions. To differentiate from the original user journey map, new touchpoints as a result of the proposed solutions are indicated by the darker yellow coloured post-its, and their respective channels indicated by the darker green post-its.

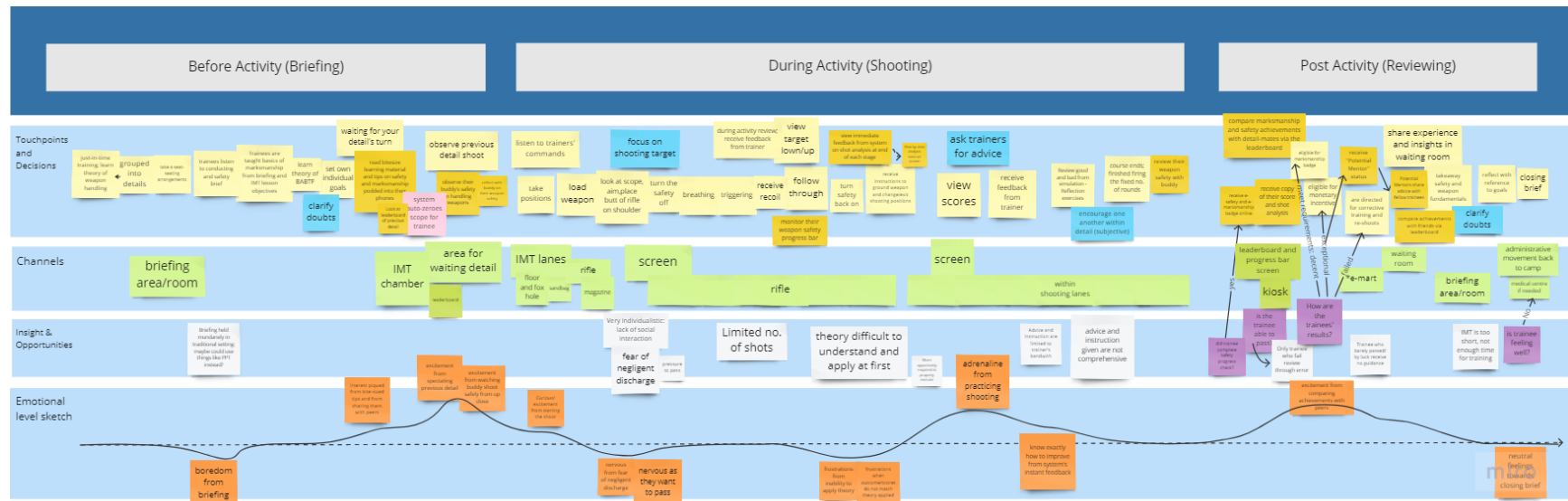


Figure E1: Revamped User Journey Map