The Project Win Game™: A Serious Game for Project Management Simulation

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Abstract: Agile project management methodology usage have grown widely in the last decade. Not all types of projects should apply agile methodologies, and the tasks that would typically be executed by a project manager are not (explicitly) addressed in agile methodologies. This paper describes The Project Win Game: a serious game for people to experience the differences in decision-making between traditional/waterfall and agile projects. The game engages an audience in complex decision-making and allows them to experience the effects of their decisions; this allows non-managers to learn project management responsibilities and translate that experience into knowledge. This paper describes the gamification of project management, the development of the game, and the lessons learned through single-player and competitive play. This paper would interest people that need to engage non-managers in management tasks and understand how a board game builds knowledge based on the experience of playing the game.

Keywords: serious game, project management, gamification

1. Introduction

Agile project management methodologies have grown widely in the last decade. Project management methodologies guide development life cycles with roles, rules, events, and practices. Agile methodology success rates are on par with projects managed under a traditional methodology such as waterfall or plan-driven (Serrador and Pinto, 2015). Some of the tasks typically executed by a project manager are not (explicitly) addressed by agile methodologies. Roles such as the team members, product owner, and project sponsors assume the informal role in some project management tasks (Sutling, Mansor, Widyarto et al., 2015, Miller, 2020). Thus, there is a need to introduce project management decision-making to a diverse group of people involved in project teams.

Decision-making is an important soft skill practiced daily by project managers as they manage schedule, quality, risks, and resources. Experience is necessary to improve decision-making skills, and project performance is correlated with accumulated project experience (Rumeser and Emsley, 2019). Mismanagement is one of the reasons for project failure. Serious games are seen as a way to build practical experience by engaging in an environment that allows experimental learning (Rumeser and Emsley, 2019, von Wangenheim, Savi and Borgatto, 2013).

Serious games are "games that engage the user and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it)" (Engström and Backlund, 2021: p. 1). They offer students an opportunity for experiential learning and constructivism; experiential learning occurs through direct experience and constructivism constructs rather than acquiring knowledge. Constructivism builds skills and critical thinking through problem-solving. "Thus, a game may provide a student the opportunity to learn in a deeper, more immersive way than what is offered from a classic lecture or even more modernized instructional media." (Thornton and Francia, 2014: p. 16).

Marcelino and Domingues (2022) found 30 serious games covering project management knowledge areas from *A Guide to the Project Management Body of Knowledge* (PMBOK guide). With the emergence of agile methods, practice games are emerging, such as the distributed agile delivery (Sharma, Kaulgud and Duraisamy, 2016, Omidvarkarjan, Conrad, Herbst et al., 2020), scrum framework (von Wangenheim, Savi and Borgatto, 2013, De Souza, Seabra, Ribeiro et al., 2017), and the Kanban method (Heikkilä, Paasivaara and Lassenius, 2016).

Although serious games have been proven as a method to build project management knowledge, understanding, and gain, they are role-specific, not broad enough, or target inexperienced students. As pointed out by Omidvarkarjan, Conrad, Herbst et al. (2020), many games do not reflect real-world challenges. They have been investigated on university students with limited industry experience. Rumeser and Emsley (2019) note that project success is a broad category whose complexity is not limited to time and costs but incorporates quality

and dealing with risk, uncertainty, and scope changes. The identified studies do not cover the impacts of the methodology decision on the project outcomes, nor do they target teaching team members to fill in the gaps.

This paper describes The Project Win Game™: a serious game for people to experience the differences in decision-making between traditional/waterfall and agile methodologies. Section two provides related work. Section three describes the gamification of project management, the development of the game, and the lessons learned through single-player and competitive play. Section four includes the discussion and conclusions.

2. Literature Review

2.1 Project Management

"A project is a temporary organization to which [human, material, or financial] resources are assigned to do work to bring about beneficial change" (Turner, 2006: p. 1). "[P]roject management is the means by which the work of the resources assigned to the temporary organization is managed and controlled to deliver the beneficial change desired by the owner" (Turner, 2006: p. 93). Project management lifecycles, activities, and roles are codified in standards and guidelines, such as "ISO 21500:2012, Guidance on Project Management" (ISO, 2012), *APM Body of Knowledge 6th Edition* (APM, 2019), and the PMBOK Guide (PMI, 2021). The traditional, waterfall, and plan-driven methodologies are lifecycles with a stage-gate or phased lifecycle with an upfront plan with the time limitation and termination conditions known when the upfront plan is created. The project management activities and control are centralized in the project manager role.

Several methodologies or frameworks follow the four values and 13 principles described in the *Agile Manifesto*. The *Agile Manifesto* provides a flexible framework for managing technology projects that responds to dynamic project situations (Beck, Beedle, Bennekum et al., 2001, Serrador and Pinto, 2015). Each agile methodology has its own roles, rules, events, and practices; however, they encourage iterative and incremental development lifecycles while using self-organizing teams to evolve the product through collaboration between the development team and the client. Scrum, XP, Lean, and Kanban are the most frequently referenced agile methodologies in surveys on agile adoption and in the project management literature (Shastri, Hoda and Amor, 2016, Miller, 2020). Some project management responsibilities are inherent in the agile methods; however, there is no explicit project manager role, and project management tasks are not explicitly identified. Table 1 identifies a set of project management tasks (from the ISO standard) that are the responsibility of other project roles in agile projects, according to Miller (2020). The table identifies the shift in responsibilities from the project manager role in traditional projects to other roles in agile projects.

The importance of decision-making skills is widely accepted as needed by a project manager. "More often, projects are unsuccessful because of project managers' failure in communicating problems, working within the culture of the organization, motivating their team, managing stakeholders, understanding strategic objectives, solving issues effectively, and making the right decisions (Rumeser and Emsley, 2019: pp. 23--24). With the decentralized project management responsibilities in agile methods, team members need awareness and understanding of their responsibility in project decision-making. Moreover, there is a difference in the project management skills needed for traditional and agile projects. Furthermore, agile methods do not apply to all types of projects, such as those that require rigorous analysis for safety- and life-critical systems (Coram and Bohner, 2005, Tanner and Willingh, 2014). Thus, there is also a need for a project manager to adapt experience and knowledge when moving from managing traditional projects to managing agile projects and for non-project managers to learn about project management responsibility.

Table 1: Distribution of project management responsibilities in an Agile Project (Miller, 2020)

	Team	Product Owner	Scrum Master	Project Manager	Other
Manage stakeholders	(+)	(+)	(+)	(-)	(+)
Establish project team	(+)	(+)		(-)	(+)
Control resources		(+)	(+)	(-)	(+)
Manage project team	(+)	(+)	(+)	(-)	(+)
Develop budget		(+)		(-)	(+)
Control costs		(+)		(-)	(+)
Identify risks	(+)	(+)	(+)		
Assess, treat, and control risks		(+)	(+)		
Select suppliers		(+)			
(+) more or (-) less responsible in agile projects than traditional/waterfall projects.					

2.2 Serious games

Engström and Backlund (2021) define serious games as engaging the player in a defined purpose. They argue that the defined purpose of play makes a serious game a utility that differentiates it from games played voluntarily for enjoyment and as an unproductive activity. Thus, the authors suggest that serious game development concepts require gameplay and utility experience, where gameplay is the interaction between the player and the game world, systems, or rules.

Świerczyńska-Kaczor and Wachowicz (2013) found that gameplay is associated with increased student engagement in learning, positive emotions, and perceived effectiveness and is a useful tool for introducing managerial or economic issues to students. Games have a distinct advantage, over other learning methods, of keeping the students engaged for extended periods. They offer students an opportunity for experiential learning and constructivism, as described by Thornton and Francia (2014). Experiential learning occurs through direct experience. Constructivism builds skills and critical thinking through problem-solving by constructing rather than acquiring knowledge.

Serious games impart knowledge by "Observing the properties and behaviors of actors and objects, Understanding the relationships between actors and objects and their effects, and Performing tasks and solving problems" (Thornton and Francia, 2014: pp. 16--17). Rumeser and Emsley (2019) refer to serious games' ability to provide an environment to build hands-on experience in complex, realistic project situations. The authors point to four advantages of using serious games for building project management skills. First, players are allowed to interact with one another in decision-making. Second, there is an opportunity to introduce many situations that require decision-making and problem-solving skills. Third, serious games can simulate the pressures project managers face in the real world. Lastly, the games can develop critical thinking and reason based on reflective thinking in decision-making.

Barbosa, Pereira, Dias et al. (2014) suggest that serious games should have a main quest and a set of related learning mechanisms. The players accumulate experience and progress through the game by solving problems through the interaction with the learning mechanisms. The learning mechanisms can be quizzes, puzzles, or mini-games. Świerczyńska-Kaczor and Wachowicz (2013) explain that for a serious game to be engaging, activity design should challenge the player's skill level with progressive levels of complexity. The interactivity, aesthetics, and quality of the game design influence player satisfaction.

2.3 Related Project Management Serious Games

Based on a systematic literature review Marcelino and Domingues (2022) found 30 serious games covering project management knowledge from the PMBOK guide. They performed a content analysis and experimentation on 12 games with a demo version and documentation. They concluded that the existing serious games cover some specific project management knowledge areas and process groups, but not all. The authors did not comment on the type of methodology—traditional or agile---applied in the games.

Rumeser and Emsley (2019) combined project complexity and decision-making into a serious game. They found that serious games can improve project management decision-making. Complex games effectively improve group decision-making performance when members have at least two years of experience. The target of the game was project managers. However, the evaluation limited performance measures to time and costs and did not include risks and scope change factors.

Like project management, some games introduce agile methods or specific practices. For example, SCRUMI introduces key concepts of the Scrum framework using an electronic board game consisting of questions and answers (De Souza, Seabra, Ribeiro et al., 2017). SCRUMIA is a pencil and paper game for developing an understanding and knowledge of applying Scrum (von Wangenheim, Savi and Borgatto, 2013). The collaborative Kanban board game addressed the Kanban workflow, lean thinking, and the related measures such as work-in-progress limits, lead time, and bottlenecks (Heikkilä, Paasivaara and Lassenius, 2016).

Games for agile practices cover delivering product features, collaborative games, and efficient retrospectives. Sharma, Kaulgud and Duraisamy (2016) used a serious game to address delivering product features as fast as possible to produce the most value possible. Przybylek and Kowalski (2018) presented collaborative games for scrum meetings to improve communication, commitment, and creativity. Collaborative games are structured

techniques to encourage communication and information exchange to solve practical problems such as product feature planning or acceptance.

The games in the project management and agile domain seem narrowly focused on either project managers or team members. The cross-over of project managers to agile or non-project managers to project management is not a transparent aim of the identified games or studies.

3. The Project Win Game™

3.1 Gamification

The gamification model canvas was used to facilitate an understanding of gamification design and to design the game (Escribano and Cp, 2017). The canvas has nine sections: platform, players, components, mechanics, behaviors, aesthetics, dynamics, costs, and revenues. It was selected as it was easy for a non-expert to understand and comprehensively identify the game and business considerations. The following sections describe the game design by canvas section.

3.1.1 Platform

The platform is the medium on which the game mechanics are implemented, e.g., computer, board, and card. The Project Win Game is a board game that simulates a 33-week project to build a smartphone. A board game was chosen for the ease of incorporating the play into face-to-face business workshops and training sessions. A physical board makes it easier for team collaboration and for an instructor to observe the players and provide feedback. A smartphone was chosen as it is most likely common to all players and thus makes it easy to understand how the pieces may be constructed through a project. Alternative product developments or game modes are possible through the blank cards provided with the game.

3.1.2 Players

The players are the people or roles that are the targets in whom we want to develop behaviors. The game is designed for one to four players, and a player may be an individual or a team. The target players' profiles are project managers, team members, scrum masters, or product owners who need to gain understanding, knowledge, or experience in the project management decisions for agile projects or the difference between agile and traditional projects.

3.1.3 Components

The board game consists of the following elements or characteristics that are the game's mechanics and give feedback to the players.

- A gameboard
- Monetary chips in four denominations
- Value credit cards in three denominations
- Six types of issues and opportunity cards
- 100 blank cards
- Numbered dice
- Colored dice

Per player:

- Numbered cards for moving around the board
- Deck of 40 team member cards
- Deck of 31 product cards
- Avatar
- Notepad and a pencil

3.1.4 Mechanics

The mechanics are the rules for how the components interact to create the game dynamics.

First, the player must select a methodology used during the gameplay. This decision influences every other decision the player will make throughout the game. In competitive play, the player with the highest amount of value credits at the END wins. The timing for when value credits are accumulated is based on the methodology.

Each team member card has a cost, a work productivity production, and several personal attributes (e.g., experience, skills). Each product feature card has a work productivity requirement and a value. The player receives a monetary budget.

The player must decide the project team composition based on team member cards and the product features based on product feature cards. The work points from the team member cards determine the number of product features that can be delivered; each team member has a cost. The value credits from the product feature cards determine the number of value credits that can be collected; each product feature requires a number of work points. The goal is to deliver the highest value credits based on a given budget. At each turn, the player selects a numbered card representing time steps to traverse the board tiles. The player reacts to the tile marking, including phase or iteration changes, change requests, risks, and issues or opportunities.

In a controlled setting, such as a workshop, players' decisions can be observed, and feedback or discussion can be provided on their decisions. That and the alternative modes of play allow for complexities to be introduced into the game. For example, the game could be changed as follows.

Table 2: Alternative playing modes

Playing mode	**Additional learning**
As designed	See behaviors
Roll numbered dice to decide the number of tiles to move forward	Uncertainty in progress
One set of team member cards per two players	Resource constraints
Mandatory cards from two decks of product cards, and then one set of product cards per two players	Competition and time-to-market leadership
A single type of issue and opportunities with no color dice roll	Specific risk management
Monitoring gameplay	Team diversity, including personal attributes and supplier decisions
Use of blank cards for project-specific modifications	Project-specific cases

3.1.5 Behaviors

In Table 3, the behaviors are the project management actions for the players. Each behavior requires one or more decisions from the player related to the project management knowledge area. The learning mechanisms are the components in the game to support the learning goals.

Table 3: Behavior, decision, and learning mechanism

Behavior	**Decision**	**Learning Mechanism**	**Knowledge area**
Selecting a methodology	• Project lifecycle	Gameboard Team member cards Product feature cards Issue and opportunity cards	Integration
Building a team	Team composition • by role • by budget • by work productivity	Team member cards	Human resources
Managing the team	• Team composition by attribute	Team member cards Issue and opportunity cards	Human resources
Deciding product features	• Product design by feature by methodology constraint • Product feature by available team productivity	Product feature cards Value credit cards	Scope
Managing change	• Aspects of the plan to change	Gameboard	Integration
Budgeting a project	• Team composition by available budget • Product features team composition by budget • Team composition by duration • Budget contingency	Team member cards Monetary chips Issue & Opportunity cards	Budget
Focusing on value	• Value by Product Feature by Team composition	Product Feature Value credit cards	Value

Behavior	Decision	Learning Mechanism	Knowledge area
Dealing with issues and opportunities	• Impact of risks on team compositions, product features, and value	Issue and Opportunity cards for six frameworks: - Process - Quality - Strategy - Structure - Team & Roles - Technology Risk tiles Numbered dice for progress uncertainty	Risks

3.1.6 Aesthetics

When players interact with the game, the desirable emotional responses expected in the player are gratification, surprise, hope, or fear. The player builds a plan to achieve the project objective, and as they traverse the board, the player must act on two fronts. First is the allocation of planned expenses for the project team and the receipt of value credits based on their plan. This action offers instant gratification when they receive a benefit (value credit) for their actions. The second aspect is responding to the issue, opportunity, or risk. The fear is that a negative issue will derail their plans; the hope is that a positive opportunity will arise. The issues and opportunities can occur through risk tiles on the board or from issue and opportunity cards. Finally, the aspect is the competition between players.

3.1.7 Dynamics

The gameplay takes at least one hour. There are 20 to 30 minutes in the planning to decide the methodology, team composition, and product features. The remaining time is spent traversing the board, responding to issues and opportunities, revising the team composition, and paying the team costs.

3.1.8 Costs and Revenues

Table 4 describes the main costs of developing the game. The game is integrated into project management workshops and does not currently have stand-alone revenue projections. It is expected to replace the lecture time in the workshop with gameplay and feedback.

Table 4: Costs by development phase

Phase	Description	Costs
Initial development	Self-developed components	Less than 50 USD
Prototype #1	Ordered individual components	460 USD
Prototype #2	Prototype from game manufacturer	600 USD
Production	20-30 games from game manufactures	10,000 – 20,000 USD

3.2 Game Production

3.2.1 Content Development

The game was developed in stages. First, a prototype was created with simply designed components based on the gamification model canvas. The game board was A3-paper size, and the cards were printed from business card stock.

Next, the components and behaviors were revised, considering the input from the participants. Game components were exchanged. For example, a spinning wheel used to simulate random issues was replaced with the issue and opportunity cards. Furthermore, the board was redesigned to have a single method for introducing issues and opportunities into the game. Specifically, time tiles that required actions due to vacations or holidays were removed. Such events were included in the issues and opportunities cards. Additional issue and opportunity cases were added. The rules were revised to address the case when a player reached the END tile while other players remained on the board. Play continued until all players reached the END or were eliminated by running out of budget; this was more consistent with the real world. The gameboard was printed on A1 paper, off-the-shelf components for the avatars and dice, and the other components were ordered from multiple vendors: self-designed playing cards, square business cards for value credits, and poker chips for the money.

In the next stage, the game was constructed using more stable pieces. The issue and opportunity were made more consistent with typical project risks. A colored dice was added to add dynamics in selecting the issue and opportunity cards. The team members were further refined to remove gender and add more attributes to the face of the cards.

The current version of the game was formalized.

3.2.2 Testing and Validation

The testing and validation of the game were done through several cycles of play with different profile people. There was a feedback session after each gameplay, and adjustments were made. Table 5 shows the people included in the testing and validation stage. Figure 1 is a photograph of the game as laid out for two players.

Table 5: Test participants

Session	Game version	Participants
1	Prototype #1	Business change manager PMP, PMI-ACP, CSM Project Manager (game creator) Project Administrator (game creator)
2	Prototype #1	Project manager Agile team member Pedagogic specialist
3	Prototype #1	Traditional Project Manager Scrum Master
4	Prototype #2	PMP and Pedagogic specialist Project Administrator
5	Prototype #2	PMP, PMI-ACP, CSM Project Manager (game creator) Student
6	Prototype #2	Project Managers (alone)
7	Prototype #2	Pedagogic specialist (alone)
8	Prototype #2	Review of instructions by a gaming specialist

Figure 1: Photograph of the game laid out for two players

3.2.3 Manufacture

The criteria for selecting a game manufacturer were based on the quantity and components availability. Many manufacturers required a minimum quantity in the hundreds. Our needs were much more conservative, with a quantity in the 10s. For the diversity of components, game manufacturers that offered individual components were added to the shortlist.

From the shortlist of available game manufacturers, five were contacted. Not all manufacturers responded. Of those that did, we received estimated costs and delivery conditions according to the components we described. We specifically requested a prototype. Ultimately, a vendor was chosen that responded and could produce all the game components.

The manufacturer provided a template for each printed component. Specifically, the box, the instructions, and the cards. We specifically requested a 3D-model be created at an extra cost for the avatars. We created all printed components using Adobe Illustrator and Adobe Photoshop. We described the color for all items using CMYK and RGB coding.

The main channel for communicating with the manufacturer was email. Responses from the manufacturer were usually within 24-36 hours.

The production of the prototype took about three weeks. We received interim content pictures, which built our excitement and anticipation.

The shipment into the European Union (EU) required content specifications according to the details from the EU declaration of conformity to pass the customs control.

3.3 Lessons Learned

3.3.1 Gamification

The gamification canvas was an important tool in understanding the necessary components and considerations in designing the game. After two brainstorming sessions, the major behaviors and components for the initial development were identified. The components and dynamics were adjusted with each gameplay during the test phase.

3.3.2 Gameplay

During the gameplay sessions, it was apparent that personal enjoyment was a factor in how people reacted to the game. Each person wanted to reach the end of the game even if someone arrived their first. Otherwise, there was dissatisfaction with the game as a whole.

Initially, there was a basic assumption that everyone knew what a methodology was. Thus, the learning was different. However, this was not the case during the testing and validation stage. Thus, the learning could be broader than expected.

During the gameplay, other discussion points included observing:

- Different mental models are used to build team compositions, e.g., all one gender and geographic region.
- Lack of planning to reach the end of the play.
- Lack of contingency planning.

There was an imbalance in the start-up and playing times for the traditional/waterfall and agile players, reflecting real life. The traditional players require significantly more consideration during the initial planning but have fewer decisions during the gameplay. Conversely, the agile players require less start-up time but have more decisions during the gameplay. This imbalance had to be compensated for in the instructions to reduce the duration of the imbalance but maintain enough difference for the learning effect.

4. Discussion and Conclusions

We presented a novel game that engages a player in complex decision-making and allows them to experience the effects of their decisions; this allows non-managers to learn management responsibilities and translate that experience into knowledge. The game-based training was tested with industry practitioners and evaluated the participants' perceived learning.

The learning incorporated project management knowledge areas, specifically integration management, methodology selection, and value-driven management. The issues and opportunities allowed the participants to experience the uncertainty associated with typical project risks or opportunities they could not plan. When played competitively, the game drives the player to focus on value creation based on the associated methodology decision.

The absence of these project management skills is one of the biggest inhibitors to project success. Existing project management games lack the breadth of project management skills needed for complex project delivery. The existing agile methodology game fails to deliver management skills to team members. No identified serious game covers the decisions impacts of methodology selection on the project execution.

The inclusion of project management elements that coexisted with the agile methodology elements enabled the novice participants to learn about agile within the application context of new product development. The complexity of the product scope with the project management elements created situations similar to real-life challenges.

The observation of the participants and their reported learnings underscore the effectiveness of using a simulation game as a learning aid.

We plan to systematically evaluate the game impact using a quantitative evaluation tool to confirm these expected benefits and the long-term effectiveness of the learnings.

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