What do Business Process Modelling and Super Mario Bros. have in Common? A Games-perspective on Business Process Modelling

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Abstract. *At first glance, it might not seem as if there was a tangible connection between playing a video game such as Super Mario World, and creating a business process model in a respective software. However, this paper argues that business process modelling itself can in fact be considered a game, and thus current issues of business process modeling such as insufficient model quality and unmotivated process modellers can be attributed to problems of the underlying "game design". As a solution, the activity of building tools for business process modeling may also be addressed using game design techniques, thereby allowing the positive impacts and benefits of games on engagement, motivation, training, and performance to be carried over to this non-game context. Such a games-perspective on business process modelling has already been assumed by a small number of researchers, as will be shown through a discussion of related work. Lastly, this paper calls for additional research situated at the intersection between process modelling and games.*

Keywords. Business Process Modelling • Model Quality • Gamification • Serious Games

1 Introduction

Business process models are important artefacts for the design, implementation, enactment, and improvement of business processes in the context of Business Process Management (BPM) (Schönthaler et al. 2012). They are created through business process modelling (BPMod), which is often conceptualized as an activity carried out by a small number of experts eliciting requirements from process end-users through interviews and questionnaires. This understanding is slowly changing, with an increasing number of authors stating that BPMod requires the active involvement of *all* stakeholders to be successful (e. g., (Bandara et al. 2005; Brocke et al. 2014)). However, such an inclusive approach to BPMod introduces new challenges, such as motivating the desired contributors to actually participate, providing tools that enable unexperienced novice modellers to contribute with little modelling skills, and ensuring that the quality of the resulting models is high enough for them to be useful (Pflanzl and Vossen 2014).

To develop solutions for these problems, some authors seek to transfer social software and its underlying principles to the BPM domain, which has led to the emergence of Social BPM (Erol et al. 2010). However, little attention has been devoted to another domain which could also make valuable contributions towards solving the aforementioned challenges: digital games. While such games are primarily designed as entertainment media and have historically been seen as unproductive and disconnected from the "real world"—a view going back to the mid-20th century, cf. Caillois (1961) and Huizinga (1949)—they are increasingly being recognized as tools for training and education that propel players towards ever-increasing levels of performance and can motivate them to continue

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playing until there is nothing left to learn (Connolly et al. 2012; Koster 2005; McGonigal 2011). This has led to the emergence of research areas such as *gamification* (Deterding et al. 2011) and *serious games* (Michael and Chen 2005), which seek to harness the potential of games for purposes other than entertainment.

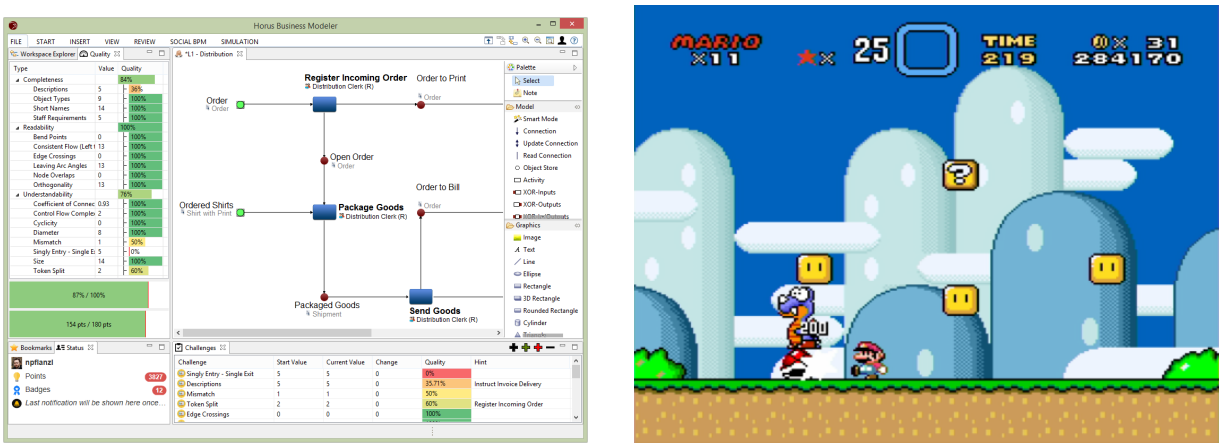
While at first glance it might not seem as if an activity such as modelling business processes (see Figure **??**) could be improved using ideas from playing games like Super Mario World (SMW, see Figure 1b) a direct correspondence between the challenges of the former and the benefits of the latter as outlined in the previous two paragraphs can be observed. This can be seen as an indication that academics should investigate the potential applications of gamification, serious games, and related fields to the business process modelling area. To open an avenue for such research, this paper argues that process modelling itself can already be seen as a sort of game, and that accordingly, many problems the discipline is facing today are the result of inadequate "game design" and implementation, and may be solved (or at least alleviated) using tools and techniques adopted from game design. To that extent, Section 2 will first substantiate this argument by contrasting and comparing BPMod and SMW against a definition of the term "game". Afterwards, Section 3 will demonstrate the relevance of a games-perspective on business process modelling by presenting existing research that has already incorporated this view. The paper ends with a brief summary and a call for future research in Section 4.

2 Business Process Modelling as a Game

Despite numerous attempts to define the term "game" (see, e. g., Salen and Zimmerman 2003, Fullerton 2008, Schell 2008), there is still no consensus about its exact meaning and characteristics. However, Juul proposes the following definition based on a synthesis of the works of many other authors: "*A game is a rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable*" (Juul 2011, p. 36). In the following paragraphs, a side-by-side comparison of the game SMW and the activity BPMod will be conducted against the components of this definition to highlight the similarities between both.

Rules. The rules are the "core of what a game truly is" (Schell 2008, p. 130) beyond its graphics, technology, and story, and are implemented through its *game mechanics* that specify the actions and behaviours that players may perform (Hunicke et al. 2004). For instance, SMW provides the basic mechanics *walking*, *running*, and *jumping*, and the rules of the game further dictate that players must finish *levels* by reaching their *goals* while overcoming *obstacles* and avoiding or defeating *enemies*. Failing to do so within a given amount of *time* causes players to lose *lives*, which may ultimately result in a *game over*. In the context of BPMod, the rules are imposed by the syntax of the utilised modelling language. For instance, Petri nets are defined as sets of *places*, *transitions*, and *arcs* so that places and transitions are disjoint and arcs may only exist between elements of different sets and thus, e. g., not between to places (Reisig and Rozenberg 1998). The game mechanics are then provided by a particular modelling tool and may consist of operations such as creating, deleting, and modifying model elements.

Variable and quantifiable outcome. A game must allow for different outcomes, and players should experience uncertainty about which outcome they are going to attain (Fullerton 2008). Furthermore, outcomes should be unambiguous and beyond discussion, which relies on the calculation of appropriate quantitative measures. For example, when playing a particular level in SMW, players may successfully reach the exit, run out of time, collide with an enemy, or fall down a pit. Further quantification is provided by indicators such as the number of collected coins or the remaining amount of time. In case of BPMod, outcomes comprise the possible models that may be created for a particular modelling task. Since this is an



(a) Horus Business Modeler

(b) Super Mario World

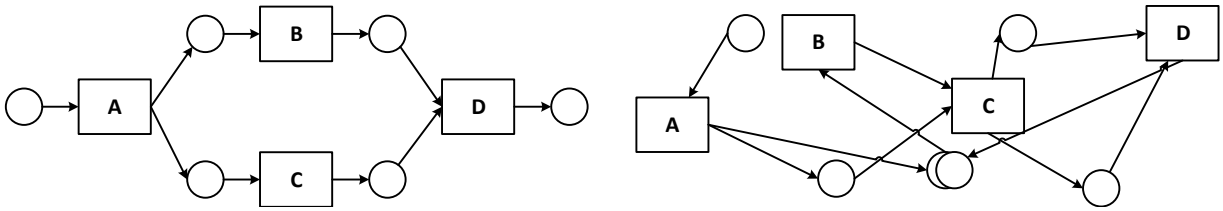
Figure 1: Modelling a business process (left) vs. playing a video game (right)

activity carried out by a human modeller based on their experience and perception, any process may be depicted in an infinite number of ways (Becker et al. 2012). These outcomes can then be quantified by means of measurement procedures for various aspects of model quality, such as readability, understandability, and completeness (Overhage et al. 2012).

Valorisation of outcome. To each possible outcome, a specific value can be assigned, e. g., a score. Based on this value, some outcomes may be considered "better" than others, and those outcomes with a higher value are typically more challenging to obtain, therefore requiring skill and expertise. For instance, players may finish one particular level of SMW with or without a power-up, and with more (better) or less (worse) collected coins and time remaining. Some levels may even offer a secret exit to be found by particularly skilled players. Similarly, two different representations of the same business process may differ in their value as measured by a set of quality metrics such as those proposed by Mendling (2008). For instance, whereas an experienced process modeller may create a highly readable model as shown in Figure 2a, a different representation of the same process constructed by a modelling novice may contain quality defects such edge crossings and node overlaps (see Figure 2b) that lower its value.

Player effort. Games are challenging and allow players to influence the outcome by investing significant effort. As such, they differ from movies and other non-interactive media where the outcome is independent of any player interaction. For example, some levels of SMW may exhibit such a high level of challenge that less experienced players can only complete them after repeated failure. Analogously, BPMod is a highly iterative process in itself, and the initial solution will most commonly not be optimal so that successive refinements must be implemented to achieve a high-value outcome.

Player attached to outcome. As a consequence of the invested effort, players feel attached to the result of a game and may experience varying emotional responses based on its outcome. For instance, whereas accomplishing a difficult level in SMW can result in a feeling of pride also referred to as *fiero* (McGonigal 2011), repeated failure may instead lead to frustration and unhappiness. Similarly, it stands to reason that a process modeller may feel, e. g., happy, anxious, or frustrated depending on whether the utilized modelling tools allow them to make the desired statements about a business process. Further emotional attachment



(a) Good configuration (b) Bad configuration

Figure 2: Quality metrics example: Planar variables

may be connected to the potential consequences of the modelling endeavour as described next.

Negotiable consequences. Based on its outcome, a game may (or may not) have optional consequences in real life that can be negotiated for any given context. This stands in stark contrast to the historic, but obsolete view that playing games is always an inherently unproductive activity that cannot serve any "serious" purpose beyond mere entertainment (Caillois 1961), and that is carried out in a safe environment clearly separated from reality, the so-called *magic circle* (Huizinga 1949; Salen and Zimmerman 2003). An example contradicting this view are the markets that nowadays exist around many games in which players can sell in-game items for money. Playing SMW in turn will most often not entail any real-world consequences, but could also be carried out as a competition or involve a bet with monetary rewards. In case of BPMod, the potential consequences of a process model depend on the purpose for which it was created, such as process improvement, certification, or software development (Becker et al. 2003). However, it may also be the case that a model is only created for documentation purposes, or is rejected due to insufficient quality.

As this discussion illustrates, SMW as well as BPMod may both considered games when evaluated against the definition provided by Juul (2011). Thus, it is reasonable to expect that some of the positive impacts and benefits of digital games may be carried over to the context of process modelling by approaching the creation of respective tools as a game design problem. Such a games-perspective on BPMod has already been adopted by other authors, as the examples presented in the following section will demonstrate.

3 Applications

Inspired by the importance of the games industry and the impacts of playing games on motivation, engagement, and skills development (Connolly et al. 2012), researchers are nowadays actively investigating how the power of games can be harnessed to solve real-world problems (McGonigal 2011). This has led to the emergence of many different research areas addressing this topic from varying perspectives, such as gamification (Section 3.1) and serious games (Section 3.2). While the BPMod discipline has been slow to investigate the potential uses of digital games, some initial research can be identified and will be discussed in the remainder of this section.

3.1 Gamification

One of the most popular approaches towards exploiting games lies in the integration of elements that are perceived as characteristic for the former into a non-game application domain while maintaining its 'serious" nature. Consequently, while the resulting activity can be more playful, enjoyable, and engaging, it should not be perceived as a game in itself. This approach is called *gamification* and is commonly defined as "the use of game design elements in non-game contexts" (Deterding et al. 2011, p. 10). A typical gamification endeavour consists of identifying goals that are associated with the use of a particular system, quantifying these goals through appropriate metrics, and then

implementing game design patterns such as points, badges, and leaderboards to motivate goal-driven user behaviour (Deterding 2015).

Initial ideas regarding the use of gamification for BPMod can be found in the area of Social BPM, an egalitarian, bottom-up approach towards BPM based on the principles of social software. In this context, EROL ET AL. suggest the use of "honour points" as a means for rewarding users based on their contributions to motivate their voluntary participation (Erol et al. 2010). These points, the authors suggest, could then be exchanged for tangible rewards such as money, acknowledgements, or certifications. Further conceptual work was conducted by RITTGEN, who proposes that BPMod sessions could also be conducted as competitive games in which a specific modelling task is given, participants create competing models, score each other, and the model with the highest score is chosen as the "winner" (Rittgen 2010). The author argues that this may serve as a source of extrinsic motivation, but does not further elaborate on the details of the scoring mechanism.

Expanding upon these theoretical considerations, other authors have described implementations of "gamified" BPMod with varying degrees of sophistication and levels of detail. For instance, AWAD ET AL. describe *ISEAsy*, a software for end-user process modelling that includes experience points and a level system (Awad et al. 2013). However, the authors neither provide information about the activities for which points are awarded, nor the benefits of gaining a level. Furthermore, the superficial discussion and lack of an evaluation prevents making any conclusions about the effectiveness of the implementation. A more elaborate approach and corresponding software prototype are outlined by HOPPENBROUWERS AND SCHOTTEN based on an interpretation of BPMod as a game with the following mechanics: modelling goals, immediate audio-visual feedback, and a score that reduces over time, thereby causing time pressure (Hoppenbrouwers and Schotten 2009). The proposed score system rewards modellers with 100 points for defining process activities, 100 points for creating control flow arcs, and 10 points for the definition of input and output objects. While the authors include game design elements as a foundation rather than secondary components, it should be noted that their scoring scheme is limited by rewarding quantity of work instead of quality.

The most extensive implementation of a gamified process modelling tool to date was presented by PFLANZL ET AL. (Pflanzl 2016; Pflanzl et al. 2017). Based on a review of literature on the quality of business process models, the prototype called *Horus Gamification* (see Figure 1a) implements a set of quality metrics addressing the readability, understandability, and completeness of process models. These metrics are the foundation for a scoring mechanism that rewards users for the quality of their models. Furthermore, users receive real-time quality feedback, have the possibility to unlock badges for notable behavior, and can compete with others on a points-based leaderboard. The implemented prototype was used in a field study with first-semester Information Systems students who were randomly assigned to either the experimental group (with gamification) or the control group (without gamification). The data obtained from the study demonstrates that gamified BPMod can lead to a statistically significant improvement of model quality for all three categories of metrics (Pflanzl 2017).

3.2 Serious Games

As indicated by the name, serious games are (digital or non-digital) games that are designed for a primary purpose other than entertainment (Michael and Chen 2005). They differ from gamified applications in that they are designed and experienced as full-fledged games rather than non-game systems that just contain elements of the games.

Very little research can be identified at the intersection between BPMod and serious games. One example is the work conducted by BROWN ET AL. who examine the use of virtual worlds as an environment for distributed, collaborative modelling sessions involving both experts and novice users (Brown 2010; Brown et al. 2011). Through this, BPMod is effectively rendered a

game that is played in a 3D environment with opportunities for additional immersion through, e. g., virtual reality headsets. Another example is Innov8 2.0, a game that was developed by IBM as a tool for educating players about the organizational benefits and importance of BPMod (Blohm and Leimeister 2013). In this game, players act as consultants and are tasked with increasing the effectiveness and efficiency of certain business processes through process re-engineering (Sumarie and Joubert 2009).

4 Conclusion and Outlook

Overall, the presented applications show that game-based ideas are slowly being incorporated into BPMod research, although in a more cautious fashion than in other disciplines. Consequently, many of the presented concepts remain superficial (e. g., by focusing on work quantity instead of quality) and include game elements as shallow add-ons rather than as an integral part of the underlying system's fabric. Furthermore, the lack of empirical data and experience reports means that any claims about the potential impacts of gamification and serious games for BPMod remains speculation and conjecture.

Beyond process modeling, some researchers have also proposed solutions inspired by game design for other aspects of the BPM life cycle, such as using gamification to educate novices about the use of a process modeling language (De Smedt et al. 2016), building a gamified and competitive system for specifying rewards and incentives for business process execution in crowdsourced settings (Scekic et al. 2012), and exploiting serious games as a tool for training end-users in process enactment (Pflanzl et al. 2016).

In conclusion, the current state of the art offers numerous possibilities for research at the intersection between process modelling and games, such as 1) examining more sophistiacted ways of gamifying existing BPMod tools that go beyond the mere integration of points, badges, and leaderboards; 2) designing and implementing serious games that teach players process modelling skills through their gameplay; 3) generating playable serious games out of reference models to provide process end-users with gameful process training; 4) studying potential uses of commercial off-the-shelf games (esp. strategy and city-building games as well as related genres) as BPM teaching tools; 5) and lastly finding new application scenarios in other phases of the BPM life cycle.

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