Engineering Motivation Requirements in Business Information Systems

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I would like to dedicate this thesis to my loving wife, Najmeh.

Abstract

Digital Motivation refers to the use of software-based solutions to change, boost or maintain people's attitude and behaviour towards certain tasks, policies and regulations. Gamification, persuasive technology, and entertainment computing are example strands of such paradigm. Digital Motivation exhibits unique properties which necessitate reconsidering its design methods. This stems from the intense human factor which may make it destructive, pressuring, and a reason for negative work ethics. The emerging literature on the topic includes engineering approaches for Digital Motivation. However, their main focus is on specifying its operation, e.g., the design of rewards and levels. This thesis conducts a series of empirical studies and proposes a novel modelling framework which enables capturing Digital Motivation as an integral part of the organisational and social structure of a business. This modelling framework provides a tool which utilises the generated models to perform analysis that informs the design, introduction, and management of Digital Motivation. The modelling and analysis framework is evaluated via case studies involving novice software system analysts, expert software system analysts, and managers of a business information system. The results of the evaluation illustrate that the modelling language has a good capability to elicit and analyse motivation requirements of stakeholders of a business information system.

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Publications Resulted from This Thesis

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2. Shahri, A., Hosseini, M., Phalp, K., Taylor, J. and Ali, R., 2014. Towards a Code of Ethics for Gamification at Enterprise. In: *The 7th IFIP WG 8.1 working conference on the Practice of Enterprise Modelling (PoEM 2014)* 12-13 November 2014 Manchester, UK..

3. Shahri, A., Hosseini, M., Phalp, K. and Ali, R., 2015. Motivation as a Supplementary Requirement. In: *The 21st International Working Conference on Requirements Engineering: Foundation for Software Quality (REFSQ 2015)* - Demo and Posters Track 23-26 March 2015 Essen, Germany..

4. Shahri, A., Hosseini, M., Phalp, K., Taylor, J. and Ali, R., 2019. How to Engineer Gamification: The Consensus, the Best Practice and the Grey Areas. *Journal of Organizational and End User Computing, 31 (1).* [Accepted]

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Declaration

I hereby declare that except where specific reference is made to the work of others, the contents of this dissertation are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other University. This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration, except where specifically indicated in the text.

The author of this thesis was the first author of all the resulted publications of this thesis.

The contribution of the first author was as follows:

- Forming and articulating the idea and aim of each paper.
- Deciding upon the appropriate methodology to be adopted in each paper.
- Designing and implementing the empirical studies presented in each paper (e.g., developing interview scripts, recruiting participants, and collecting the data).
- Analysing and interpreting the collected data and drawing the conclusions (e.g., quantitative and qualitative analyses).
- Reporting the findings and fully writing each paper.

The co-authors contributed to the published papers in terms of verifying and validating the studies' findings by comparing them against the actual responses from the participants. They also provided guidance and feedback on the structure and overall articulation of the papers' message. In addition, they gave insights on the methodologies and also checked the quality of the papers and suggested modifications on some parts of the text. Furthermore, the co-authors enriched the papers with the appropriate terminologies in certain places, especially those related to the venue where the papers were published.

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Chapter 1

Introduction

Requirements Engineering (RE) is one of the early stages of the software development cycle which focuses on elicitation, evaluation, specification, and maintenance of objectives, functionalities, qualities, and constraints of environments, such as business information systems (BIS), to be achieved through a software-intensive system (Van Lamsweerde, 2009). RE processes help software engineers in understanding and defining the problem which the software intends to solve. Understanding and defining the problem involves discovering, and agreeing on what the problem is, why the problem should be solved, and who the stakeholders are. Moreover, software engineers need to address the problem through formulating, modelling, and analysing the requirements (Van Lamsweerde, 2000, 2009).

RE categorises the software system requirements into functional requirements and non-functional requirements (NFR). Functional requirements are considered to be crisp quantitative behaviours that a system must be able to perform (Sommerville, 2010) which define *what* the system should be able to achieve. On the other hand, NFRs refer to qualitative behaviours of a software system which define *how* the system should perform and work (Stellman and Greene, 2005).

In terms of RE, **motivation** has not seen a comprehensive discussion in the field of software engineering. Motivation is in the interest of various disciplines and has been studied in their respective contexts, e.g., psychology (Atkinson, 1964), business management (Frey and Osterloh, 2001), education (Deci et al., 1991), and healthcare (Brug, 2008). Despite numerous definitions of motivation in the literature (Kleinginna Jr and Kleinginna, 1981), a widely accepted definition for motivation is the "psychological processes that cause the arousal, direction, and persistence of behaviour" (Mitchell, 1982). The main driver for motivation is motive, described as the substance that can encourage or increase the will in people to act in a certain manner (Fremont and Rosenzweig, 1988).

From the perspective of RE, motivation can be considered as a requirement. However, since motivation is not the main goal and requirement to be achieved and addressed, it can be seen as a supplementary requirement in which complements other functional and non-functional requirements (Shahri et al., 2015). Various motivational theories exist, aiming at understanding human needs, desires, and motivation. Namely Maslow's hierarchy of human needs (Maslow et al., 1970), and Alderfer's ERG theory (Alderfer, 1969a) as general human motivation theories, and Herzberg's Two factor theory (Herzberg, 1966) as employee motivation theory.

Maslow's hierarchy divides human needs into a five-level pyramid, covering basic human needs at the bottom and advancing to more cultivated needs in each higher level in the pyramid. Maslow believes that humans will feel for a need in a higher level of the pyramid once the needs from the lower levels are satisfied. However, Alderfer did not agree with this rigidity in the order of human desires and proposed the ERG theory which has three tiers. The ERG theory recognises that people differ from each other, which is inferable that they may have distinctive needs and desires, and the order of needs in Maslow's hierarchy may not apply to them fully. In addition to Maslow's hierarchy of needs and Alderfer's ERG theory, Herzberg introduced the two-factor theory which is applicable in the field of job satisfaction. Herzberg divided employees' motives into two classes – motivators and hygiene factors. According to Herzberg, hygiene factors are necessary for maintaining the motivation level in employees, e.g., job security. However, hygiene factors will not have a positive impact on employees' motivation and would not cause an increase. Herzberg believes that organisations should focus on motivators, e.g., social recognition, to increase the job satisfaction and motivation level in employees. Herzberg's theory argues that an increase in motivation is more complex than mere satisfaction of humans and in particular employees' basic needs. Herzberg argues that there is a need for considering a distinction between lower level needs in Maslow's human needs or hygiene factors which are necessary for maintaining employees' motivation, and motivators which are human needs from higher layers of Maslow's pyramid. Herzberg has been criticised by Shipley and Kiely (1986) and Schroder (2008) for over simplifying the job satisfaction and not considering individual differences such as age, gender, and social status.

With the emergence of computers and the rapid integration of digital means in human life, motivation was not an exception, and its various digital forms have emerged. Digital motivation (DM) does not change the core concept and definition of motivation and revolves around the use of software and digital solutions to embed motivation theories into traditional situations where the use of motivational theories is deemed necessary or desirable. Examples of DM are gamification (Deterding et al., 2011a), serious games (Susi et al., 2007), games with a purpose (GWAP) (Von Ahn et al., 2006), and persuasive technology (Fogg, 2002a).

One example of a DM design is gamification, defined as the integration of "game elements" in a context other than games (Deterding et al., 2011a). Gamification has been used in various contexts, such as educational environments (O'Donovan et al., 2013), health related applications (King et al., 2013), and marketing (Huotari and Hamari, 2011). It seeks to achieve a behavioural change in its users through increasing the motivation by introducing elements and concepts from game design. The addition of these elements aim at providing several facets which users may find interesting such as social recognition, competition, and personal achievement.

Another example of a DM design is the concept of serious games, which is defined as the use of fully fledged games to achieve goals other than mere entertainment (Susi et al., 2007). Serious games have mainly gained attention in the area of education, experiencing the term *edutainment* interchangeably. Serious games have story lines similar to conventional video games, aiming at enhancing the learning experience of its users through entertainment.

GWAPs are another set of DM design, following specific goals through the implementation of games. These goals revolve around, but are not limited to, performing tasks which require considerable processing load on computers but are easy for humans to perform (Von Ahn et al., 2006). Instances of GWAPs are applications where the number of objects in a picture needs to be calculated. This counting task is inherently easy for humans to perform but require complex algorithms, with heavy processing loads with errors to be expected. GWAP may also be used in persuading people towards practices which help to achieve a greener environment, such as consuming fewer paper prints.

Persuasive technology (Fogg, 2002a) is another DM design, aiming at changing the behaviour of its users through interactive products. These products are based on seven persuasive tools proposed by Fogg (2002a).

Despite all the definitions provided for these various DM design techniques, there is yet to be depicted a clear line between them. Although gamification is defined as the use of game elements in a non-game context, it is arguable that education is a non-game context, and serious games facilitate game design elements with an educational purpose. The major difference between gamification and serious games could be considered as the element of entertainment, which brings another argument, whether gamification requires entertainment and if not, would users find its design interesting enough and motivating. Drawing a line between serious games and GWAPs is challenging as well since the definition for both can be used interchangeably, being fully-fledged games following ultimate goals and purposes other than enjoyment.

Motivation in its digital form incorporates elements originating from various disciplines such as psychology (Webb, 2013), gaming technology (Llagostera, 2012), and business (Herzig et al., 2012). The main objective of DM is to increase motivation and engagement of its users through elements from game design, e.g., points, leaderboards, rewards, progress bars, or badges. Digitalisation of motivation introduces new characteristics to it which is not present in its conventional form. These characteristics emerge from the use of software and the need for storing and processing data using the software. DM allows real-time capturing of data, high-speed data processing, and can make the data available to a large audience. As a result, digital form of motivation has characteristics which were not examined while being studied in various fields of research. Initial results of this research indicate that a well-designed implementation of DM can enhance a number of quality properties such as productivity, collaboration, and also the social and mental well-being within a workplace. However, a reckless implementation of DM may have adverse side effects and menace the aforementioned properties (Shahri et al., 2014).

To prevent a harmful design of DM, available systematic approaches towards its design need to be studied. Since DM is focused on human behaviour regardless of the domain it is being applied to, the engineering of it is inherently a human-centred software engineering. There are a variety of disciplines involved in the development of DM; thus, the perception of how it has to be introduced to a system is diverse. While some studies consider engineering of DM as a software engineering issue (Oldenhave et al., 2013), other studies view it as an additional layer or a mechanism to be added on top of existing software systems (Nicholson, 2012). Also, while the main idea of DM seems to introduce enjoyment to the environment, a number of studies suggest that the element of enjoyment is optional (Nicholson, 2012; Padilla et al., 2011). Furthermore, it is believed that certain game elements are suitable for certain tasks, and also, there is a degree of compatibility between game elements themselves. Generally, DM is being introduced and applied to systems in an ad-hoc manner. As it is derivable from the literature, there is little common understanding and well-accepted engineering foundations for DM and recommendations on its usage (Seaborn and Fels, 2015; Shahri et al., 2017).

Usually, motivation is not the main requirement of a software system, and it is regarded as a supplementary requirement, providing support for main functional and NFRs in a software system (Shahri et al., 2015). As a result, there has been little focus on engineering foundations and conceptualisation of DM, which in turn, drives DM designers towards ad-hoc designs. DM is widely used in commercial environments and business information systems (BIS) as a tool to increase the motivation and engagement of employees. DM targets the end-users and tries to provide motives which may increase the motivation of the end-users and persuade them to perform desirably from the perspective of the BIS. Nevertheless, DM relies on the opinions and preferences of its users with regards to their motivation requirements (Shahri et al., 2016) which may be ignored in ad-hoc designs of DM.

A failure in considering the motivation requirements of end-users in a context other than BIS, e.g., advertisement, may not have a negative impact other than loss of a customer. However, this failure in a BIS may raise ethical issues and menace the social and mental well-being of the employees involved in the implemented DM (Shahri et al., 2014). There are a vast number of considerations which should be duly studied prior to the implementation of DM in a BIS to control and prevent the emergence of ethical issues.

In addition to the ethical issues which may occur in a BIS with the introduction of DM, providing the correct DM settings (Shahri et al., 2016) and also sustaining end-users motivation is another challenge which needs to be tackled (Nicholson, 2012). The problem arises from the fact that users may not find the DM design helpful and interesting and may not show enough engagement with the implementation since the design does not comply with their preferences. In addition, users may even lose their interest in motives they used to find motivating over the course of time.

1.1 Research Aim

In consideration of the aforementioned issues, challenges in the design of DM, and the limited research in engineering foundations of DM, especially in the context of BISs, this research aims to provide an engineering solution to elicit motivation requirements of members in a BIS and guide the design of DM to address the motivation requirements to stakeholders satisfaction, in light of ethical and organisational considerations. This engineering solution will conceptualise DM in the context of BIS, which will aid in eliciting motivation requirements, a persona-based guideline which helps in clustering the end-users with similar preferences on DM, provide a modelling language and its formal specification for digital motivation in the context of BIS, which will enable modelling of the requirements motivation and their automated analysis, and a requirement driven architecture which will guide the design of DM in an adaptive manner.

1.2 Research Question

Based on the aim of this research, the following research question can be formed:

> How can motivational requirements be modelled in a business information system, how can they be analysed based on the capabilities of the model, so that such an analysis illustrates the effects of digital motivation on the business information system, and how can motivation requirements life-cycle be systematically adapted considering the vigorous social aspect of digital motivation?

1.3 Research Objectives

To successfully achieve the aim of this thesis, this research has conducted the following objectives:

Objective 1: Background research/literature review and identify the gaps in the literature

The first objective of this research is to identify the current methods, approaches, foundations used to implement digital motivation, and also identify gaps and lack of information in the literature. This research tries to accomplish this by reviewing available literature and also a mixed method expert opinion study.

Objective 2: Develop a method to enable a systematic approach towards implementing digital motivation

To enable a systematic approach towards introducing digital motivation to a business information system, this research tries to perform content analysis on the results from the expert opinion study to identify components, properties and attributes that characterise digital motivation. These constituents are necessary to design an effective digital motivation. Moreover, it is essential to find relations amongst these constituents and possible outcomes of combining them together. A user study will be conducted in order to understand the relations between different settings of digital motivation and their compatibility with the given business information system. Next, a user study will be conducted to help to develop a user-centred design approach for a compatible design of digital motivation in a business information system with its end-users.

Objective 3: To develop an automated analysis mechanisms which enable the processing of digital motivation and detect shortcomings and inconsistencies in the design

To equip the system with a semi-automated decision-making ability, this research tries to design an expert system alongside with a recommender system. The knowledge base will use the results from the experts and the user study. The recommender system can use either forward chaining or backwards chaining. In the case of using forward-chaining, the recommender system will ask for characteristics of the business information system as input and suggests the best setting for the motives according to its knowledge-base. On the other hand, in the case of a backward-chaining, the input will be the setting for motives, and the recommender system suggests characteristics of the business information system that the settings are compatible with. The results of the expert system are provided to authorities of the organisation as suggestions to make the final decisions.

Objective 4: Evaluate the modelling and analysis framework for Digital Motivation

This research tries to evaluate the modelling language and the digital motivation systematic approach for its usefulness and effectiveness from the perspective of novice software system modellers, expert software system modellers, and business information system managers through lab sessions, focus groups, interviews, and case studies.

1.4 Thesis Structure

This thesis is structured as follows, and its flow is illustrated in Fig. 1.1. Chapter 2 presents the extensive multi-disciplinary literature study which was performed on motivation, digital motivation, and other relevant topics. In chapter 3, the research methodology followed by this thesis is presented, discussing various research philosophies, possible options for this research and presenting the one which is suitable for this research. In chapter 4, results from the expert studies are analysed and provided, which enlightens the research with current ambiguities, debates, issues, common practices, and recommendations in the field of DM. Chapter 5 delves into the ethical issues which may arise by the introduction of DM into a BIS and discusses

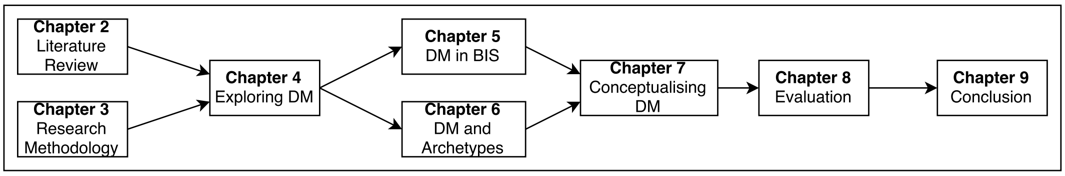


Fig. 1.1 Flow of the Chapters

the possible solutions to address this matter duly. Chapter 6 provides a user-centred design approach towards designing a DM which enables a more compatible design to the end-users in a BIS. Chapter 7 a modelling language, digital motivation modelling language, is proposed which enables modelling, analysis, and reasoning for motivation requirements and implements an expert system which uses facilitates the modelling language and provides an automated reasoning. Chapter 8 evaluates the modelling language for effectiveness and usefulness in analysing the requirements model and detecting possible outcomes of the designed DM within a given BIS. Finally, Chapter 9 concludes the thesis, summarises the contribution of this research, and suggests future work on the topic of digital motivation requirements modelling and analysis.

Chapter 2

Literature Review and Background Study

This chapter presents the research already undertaken in the field of motivation and the digital form of motivation. The main focus of this chapter is on the theories, definitions, concepts, constituents, and systematic approaches towards the design and implementation of motivation and its digital form. Motivation and specifically its digital form are added to environments with the intention of increasing the engagement to the tasks and willingness to change behaviours towards desired conducts. This research narrows the domain of its study to a socio-technical system and specifically, in a business information system.

This chapter begins with a presentation of motivation from the perspective of psychologists and then provides differences between classical motivation and its digital form. Moreover, various types of digital motivation are investigated, and systematic approaches for their design and implementation are studied. Finally, the problems in the field of digital motivation are identified, and software engineering concepts, methods, approaches, and tools which may help to resolve the problems are presented.

2.1 Motivation

Motivation, widely defined as the instigation and direction of behaviour in humans (Elliot and Covington, 2001), relies on motives. A motive is a substance that can cause the development of an inclination in humans towards specific behaviours (Pardee, 1990). Motivation helps individuals pursue certain goals, for example enhance achievement in education, enhance fitness level or smoking cessation.

There exists a rich and extensive body of knowledge on motivation in the field of psychology. Several models and theories are trying to investigate and understand human behaviour and motivation (Miner, 2015). A number of these models and theories are approach and avoidance theory, protection motivation theory, incentive theories, sociocultural theories, and content theories which are described as follows:

2.1.1 Need Theories

Need theories study motivation from the human needs perspective, arguing that humans become motivated as a result of their needs, investigating what those needs are and how they can be utilised to increase motivation in humans (Pritchard and Ashwood, 2008). The following describes three known content theories; Maslow's hierarchy of human needs, Herzberg's two-factor theory, and Alderfers' ERG theory.

Maslow's Hierarchy of Human Needs

Maslow's (1943) hierarchy of human needs as illustrated in Figure 2.1, depicts a five-level hierarchical pyramid of human needs where the bottom level relates to primitive physiological drives (e.g., food, water, sleep) and the top level relates to self-actualisation needs (e.g., morality, creativity, problem-solving). Maslow's (1943) theory states that when a need from a specific level is satisfied, humans will crave for a need from a higher level.

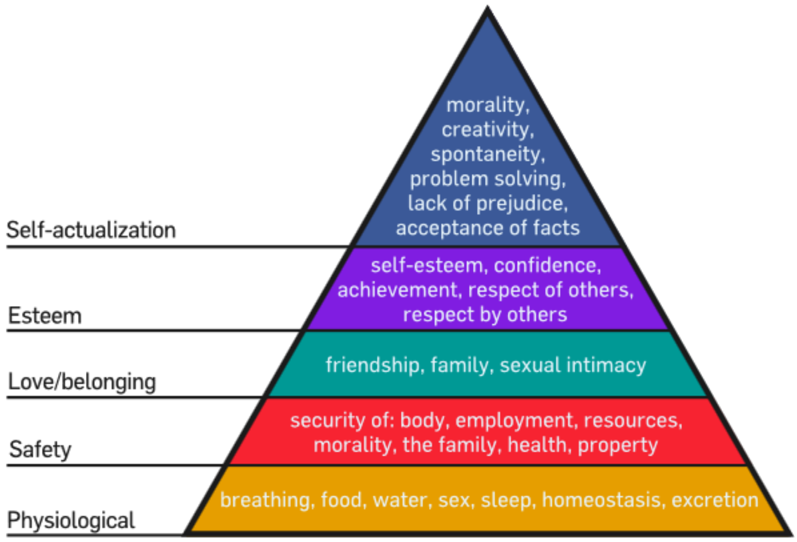


Fig. 2.1 Malsow's hierarchy of needs

There have been discussions about Maslow's (1943) hierarchy of human needs in the literature, which include some critics to this theory. It is argued that human needs in this theory do not follow a hierarchical order and also this theory does not consider societies that people have grown up in (Hofstede, 1984; Wahba and Bridwell, 1976). For an example, the need for survival from level two of the Maslow's hierarchy is not achievable without collaborating and communicating with others, which is a requirement listed in level three of the hierarchy.

Alderfer's ERG Theory

As illustrated in Figure 2.2, Alderfer's (1969) ERG theory consists of three levels of needs: Existence, Relatedness, and Growth. Alderfer's ERG theory classifies motives similar to Maslow's hierarchy of needs (Alderfer, 1969b). However, the theory argues that the complexity of human satisfaction and motivation is far greater than what is described in Maslow's (1943) hierarchy of needs. Alderfer (1969) believes that people can have physiological needs and social needs at the same time and there is not any specific order in satisfying human needs. Besides, the theory

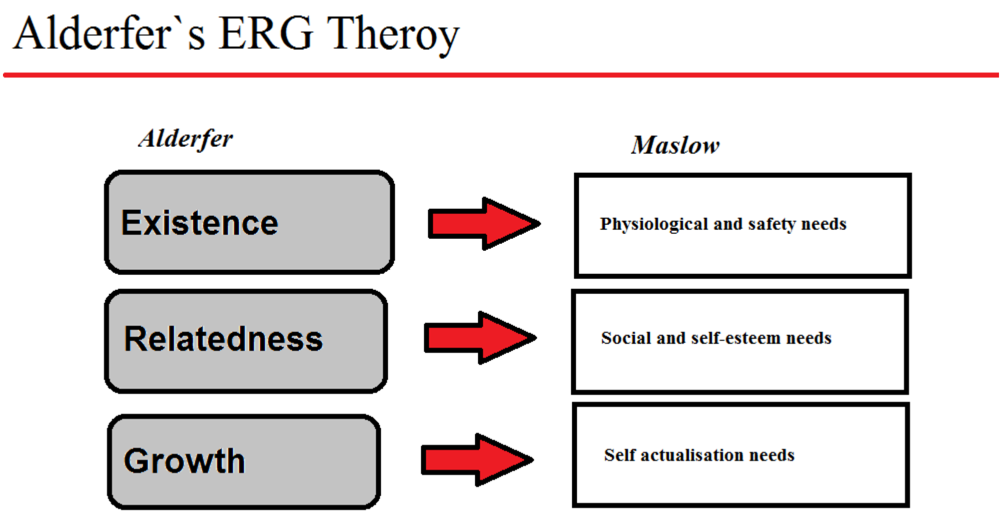


Fig. 2.2 Alderfer's ERG theory

argues that the importance of human needs is subjective to human characteristics and circumstances. The existence level could be mapped to the physiological and safety levels of needs in Maslow's (1943) hierarchy. Next is relatedness, which can be mapped to Maslow's (1943) social needs and partially to the needs classified as esteem needs. Finally, growth relates partially to esteem and self-actualisation needs of Maslow's (1943) hierarchy.

In contrast to Maslow's (1943) hierarchy of human needs, this theory recognises that people vary from each other and the needs of some individuals may be different from others. Also, Alderfer does not suggest a fixed order for human needs. However, the human needs in this theory and the measurement of the three levels are not clearly defined, and with the current tools, it is hard to test and use the theory. As a result of these shortcomings, this approach is less used within the literature.

Herzberg's Two-factor Theory

Herzberg's two-factor theory is highly focused on job satisfaction and classifies motives in two categories: motivators and hygiene-factors. According to this theory, the presence of motivators (e.g., social recognition, problem-solving) can increase employees' motivation and can have positive impacts. However, the presence of hygiene-factors (e.g., job security, salary) will not necessarily lead to an increase in motivation or satisfaction, although their absence could cause a decrease in motivation and satisfaction.

While creating a distinction between motivators and hygiene-factors is interesting, this theory has been criticised for oversimplifying the job satisfaction (Shipley and Kiely, 1986). Moreover, another critic to this theory is the lack of individual differences such as age, gender, and social status which can affect job satisfaction (Schroder, 2008).

2.1.2 Incentive Theories

Incentive theories divide motivation into intrinsic and extrinsic motivation. Intrinsic motivation refers to performing specific behaviours for the performers' inherent interest and joy, and extrinsic motivation refers to performing specific behaviours for the sake of achieving other outcomes (Ryan and Deci, 2000).

It has been shown that humans and animals may not necessarily seek a reward to be engaged in activities they are intrinsically motivated to perform, and if they find the activities playful. This engagement means that there is no need for an external source of motivation if people are involved with the activities autonomously, are performing with a low level of external control. Hence, there is no conflict with other desirable outcomes for the individual. (Ryan and Deci, 2000; Wigfield et al., 2004)

Despite several positive aspects of intrinsic motivation, such as long-lasting and self-sustaining, it has been argued that intrinsic motivation can be hard to foster in people. One of the reasons for this difficulty is the reduction in intrinsic motivation that humans experience as they age. One reason for this decrease in motivation is the impact that social pressure and demands for taking non-intrinsically motivating tasks have on people's freedom to be intrinsically motivated. Another obstacle is that intrinsic motivation requires novelty, challenge, or aesthetic value in the tasks for that individual which is a challenge to provide in every case (Ryan and Deci, 2000)

As discussed, the introduction of intrinsic motivation to people is challenging, and the individuals generally possess or do not possess the intrinsic motivation towards certain behaviours. Extrinsic motivation can be employed to fill in the motivation gap and provide those who lack intrinsic motivation in engaging in the desired behaviours with a source of motivation. Extrinsic motivation provides an external source of motivation separate from the behaviour or task itself, such as a reward, in which individuals find interesting and perform the tasks to satisfy their interest in the external source of motivation, e.g., winning a prize.

Despite this classification, it is not an easy task to categorise one's motivation into pure extrinsic or pure intrinsic. According to the taxonomy proposed by Ryan and Deci (2000), there are three core levels of human motivation. First is **amotivaiton**, that is the complete absence of intention to perform certain behaviours. Second is **extrinsic** motivation in which has four sub-levels on its own. First sub-level is **external regulation**, which describes the intention to carry out specific behaviours to satisfy external outcomes. Second sub-level is **introjected regulation**, that is the intention to perform certain behaviours to avoid guilt or anxiety or achieve ego and pride, in other words, **introjected regulation** refers to the motivation to enhance self-esteem in individuals. Third sub-level is regulation through **identification**, that is the acceptance of the person about the importance of the behaviour in enhancing other external gains. Moreover, **integrated regulation** as the fourth and last sub-level is the closest form of extrinsic motivation in the spectrum to intrinsic motivation. **Integrated regulation** is similar to intrinsic motivation in the sense of being autonomous and unconflicted. However, the intention of performing the behaviour is still external outcome and separate from the behaviour itself. Third and last core classification in Ryan and Deci (2000) taxonomy is the intrinsic motivation.

Lepper et al. (1973) has argued that the presence of extrinsic motivation will undermine the intrinsic motivation in individuals. However, several studies challenged this view and suggested that the question should change from whether extrinsic motivation undermines or enhances intrinsic motivation (Cameron and Pierce, 1994; Deci et al., 1999). These studies debate that this problem is related to the design of the motivational techniques, and the actual question should be in which circumstances, the introduction of extrinsic motivation enhances or undermines intrinsic motivation in individuals (Cameron, 2001; Deci et al., 2001). Marinak and Gambrell (2008) suggest the design of extrinsic motivation should be a proximal reward to the desired behaviour to prevent the diversion of the focus from the intended behaviour, such as providing a book as a reward for a book reading competition. This proximal rewarding can avoid adverse side effects on the intrinsic motivation of the individuals by not diverting the focus from the desired behaviour, which is reading a book in the provided example.

2.1.3 Approach vs Avoidance

Based on the approach and avoidance theory, humans are motivated either to gain benefits or to prevent harm. Approach motivation refers to a positive or desirable event that motivates humans to pursue certain behaviours, and avoidance motivation relates to the instigation of motivation via a negative or undesirable possibility to avoid its occurrence (Elliot, 1999).

2.1.4 Protection Motivation Theory

Protection motivation theory or fear appeal theory refers to humans' desire to protect themselves from threats (Maddux and Rogers, 1983). A threat is defined as the harm which can be caused by danger, and characterised by its degree of severity and also to the level of which one may feel endangered by this threat (Peters et al., 2013). As

Peters et al. (2013) stated, the fear appeal will not lead to a change in behaviour if the severity of the threat is not deemed high, one is not susceptible to the threat, or one is incapable of providing an effective action in response. Therefore, a successful implementation of protection motivation should adequately inform the subjects with the severity of the threat and provide with alternative achievable solutions illustrating how the threat can be alleviated or prevented.

2.1.5 Sociocultural Theories

Sociocultural theory considers motivation as a context-dependent phenomenon towards a view which highlights the *interdependence* of motivation and the social settings in which individuals reside in (Rueda and Moll, 1994). The sociocultural theory would be a situation where humans try to solve problems collectively, such as in a football team. Despite behaviours that will benefit personal interests of the individuals, people develop goals for others in which they would help them achieve (Walton and Cohen, 2011). An example of this situation is where players of a football team help another player to become the best scorer of the season if there is a chance.

Minick (1993) has also highlighted the importance of the social context in motivation and concluded that individual psychological and motivational characteristics do not exist separate from the social context. Rueda and Moll (1994) describe the key elements of a sociocultural approach to be, “the role of social interactions, the influence of culturally based knowledge and practices, cultural tools, peers or more competent others, and a focus on thinking as inseparable from social and cultural activities within the context”.

2.2 Digital Motivation

Digital motivation (DM) (Algashami et al., 2017) revolves around the use of software solutions to facilitate motivation theories and increase the will of people to follow certain behaviours and prevent or reduce undesired ones (Lister et al., 2014). For example, facilitating the approach and avoidance theory, it is used to encourage adherence to fitness programs (Molden et al., 2008) and to assist smoking cessation (Pløhn and Aalberg, 2015). DM builds on classic motivation research, widely defined as the "psychological processes that cause the arousal, direction, and persistence of behaviour" (Mitchell, 1982). Some examples of the classic motivation theories used in DM are incentive theory, a widely used constituent of DM, persuading people by providing them with virtual goods or tangible rewards. Another is the approach and avoidance theory which is facilitated in various cases, e.g., presenting messages to encourage or discourage certain behaviours. In both classic motivation and DM, the factor which facilitates an increase in the will of a person to follow certain behaviours is called a "motive" (Fremont and Rosenzweig, 1988). Gamification (Deterding et al., 2011a), Games with a Purpose (Von Ahn and Dabbish, 2008), Serious Games (Abt, 1987), and Persuasive Technology (Fogg, 2002a) are examples of paradigms that employ DM and use digital and software-based motives.

2.2.1 Gamification

Gamification is defined as the selective implementation of game elements in a context other than games (Deterding, 2012; Deterding et al., 2011a,b). Gamification as it is known today, ultimately aims at creating digital interactive systems with the purpose of increasing motivation and engagement to change human behaviour towards desired outcome, whether through *approach* theory such as fitness programs (Molden et al., 2008), or *avoidance* theory such as persuading people to quit smoking (Pløhn and Aalberg, 2015). In contrast to what it may appear, gamification is not a new paradigm, having roots in the marketing sector and other domains. Nevertheless, there is yet to be an agreed standard definition and consistency in theoretical and conceptual aspects of it (Seaborn and Fels, 2015).

Since coining the term gamification, several attempts have been made to establish a standard and commonly accepted definition of it (Deterding et al., 2011a; Huotari and Hamari, 2012; Werbach and Hunter, 2012). However, there are still many gaps, debates, and ambiguities present in the literature that are yet to be investigated. For example, it is not clear which constructs and properties shape gamification, and how it can be differentiated sharply from other similar concepts, such as serious games or games with a purpose.

Moreover, some attempts made towards introducing a methodology for designing gamification from a business-oriented point of view (Herzig et al., 2015). Nonetheless, it is not yet clear which stakeholders and which fields of studies need to be involved in the design process of gamification from a wider perspective, e.g., impacts it may have on social and psychological well-being of its users. Besides, there are several debates on when gamification can be introduced to an environment, what concerns it produces, and which considerations may lead to a successful design of gamification in that environment. Finally, what issues, from a legal or ethical perspective, may arise from the use of gamification and how these issues need to be tackled.

In an attempt to understand gamification, the differences between *play* and *game* need to be addressed. This differentiation can clarify the distinction between gamification and video games. According to Caillois and Barash (1961), play (paidia) is free-form, expressive, improvisational behaviours and meanings. Game (ludus), on the other hand, is rule-based engagement with pre-determined goals. Gamification, as the name suggests, is more focused on ludus, nevertheless, as Alfrink (2011) suggests, users are not given much flexibility to improvise their behaviours, and they have to do/achieve pre-determined tasks/goals. Despite the opinions of Abt (1987);

Bogost (2011) for excluding playfulness, playful design, and playful interaction from gamification, it is believed that gamification can also facilitate playful behaviours and entertainment to achieve its goals (Groh, 2012). However, including entertainment in a gamification design does not guarantee its success (Berkling and Thomas, 2013).

There has been a number of attempts to study gamification from conceptual and theoretical points of view which are as follows:

Gamification in Theory

In an attempt to conceptualise and define gamification, Deterding et al. (2011a) investigated the literature from academic and industrial perspective and idendified several parallel terms which are being used such as productivity games (McDonald et al., 2008), surveillance entertainment (Grace and Hall, 2008), fun-ware (Takahashi, 2008), playful design (Ferrera, 2012), behavioural games (Dignan, 2011), or game layer (Priebatsch, 2010). Despite the observed wide range of theoretical trends and ontological studies, Deterding et al. (2011a) could not find an umbrella term which could cover all examples of gamification and gameful design, with the pure non-game intention. Hence, the authors proposed their definition and terminology of gamification, suggesting that gamification should involve "*gamefulness* (the experiential and behavioural quality), *gameful interaction* (artefacts affording that quality), and *gameful design* (designing for gamefulness, by using game elements)". Authors emphasise that this should be considered separate from *serious games* as it is not a *full-fledged* game for non-entertainment purposes, but mere incorporation of game elements or as Brathwaite and Schreiber (2009) described, game "atoms".

Huotari and Hamari (2011) described gamification to be a rules-based service system that provides feedback and interaction mechanism to the user with an aim to facilitate and support the users' overall value creation. In addition to increasing motivation and engagement, their definition of gamification emphasises that adding gamification to a working environment should lead to the creation of added value to the business, for example, increasing staff engagement with the affordance of graceful experience. However, Deterding et al. (2011a) criticise this definition for being not specific enough, arguing that with this definition, even a touch screen on a vending machine would be considered as a gamified application.

From a practitioners point of view, Zichermann (2011); Zichermann and Linder (2010) discussed gamification and motivation from a psychological perspective in the marketing industry, comparing the impact of *intrinsic* and *extrinsic* motivation. They believed that despite positive impact that intrinsic motivation has, it is unreliable and volatile, suggesting that more emphasis should be given to extrinsic motivation. In an attempt, Zichermann and Cunningham (2011) proposed a gamification design path and describe various game elements and game mechanics through illustrative examples. The proposed design path helps in the identification of system players, how players can achieve mastery in game elements, methods of familiarising new users to gamification, and the role of social engagement. The authors consider the following game elements to be essential for a gamification design: feedback and reinforcement, pattern recognition, collecting virtual goods, organising, surprise elements, rewarding strategies, positive messages, social recognition, and leadership. However, these arguments and design paths are challenged to be incomplete which do not cover the full circle of gamification design and user experience and are criticised to lack the data and rationale behind the arguments (Deterding et al., 2013).

The design of gamification can target both intrinsic and extrinsic motivation. A design of gamification that targets the intrinsic motivation can deepen the motivation and engagement in its end-users. It is argued that introducing extrinsic motivation through gamification to motivate users may only have short-term positive results (Deterding, 2012; Lazzaro, 2011). Despite this argument, Reiss (2012); Ryan and Deci (2000) suggested that extrinsic motivation should not be excluded or should not be considered as a separate source of motivation, considering extrinsic motivation to be equally important as intrinsic motivation. This proposition is made based on the fact that people are intrinsically and extrinsically motivated to various degrees. Excluding extrinsic motivation may fail to provide those people who require a trigger for being more engaged and motivated to perform certain tasks. Nonetheless, Zichermann (2011) argues that financial and monetary extrinsic motives can lead to a decrease in motivation, despite improving performance. The reason for the decrease in motivation is monetary reward may shift the focus from the actual task to the reward itself, and over the course of time, this can divert the ultimate goal of performing the tasks to achieve the monetary reward.

Other critiques to gamification, mainly from experts in gaming, suggest that gamification is focused on the least important aspects of games and that is being used as a tool for mere "pontification", whereas games have storylines, and valuable and meaningful contents for their players (Chorney, 2013) that do not exist in gamification. The lack of the aforementioned features removes the entertainment and makes the task only challenging, whereas games should be "interestingly hard and difficult", giving players joy while performing and achieving a goal (Robertson, 2010). In addition, Deterding (2012) suggest and stress the importance of intrinsic motivation and "meaningful play" for gamification and state, a gamification design that does not understand the needs and requirements of its stakeholders, is destined to fail.

How to Apply Digital Motivation?

This section presents a number of frameworks and approaches which are being used in academia and industry. These frameworks and approaches are specifically designed and crafted for guiding the path through the design processes of DM, and gamification in particular.

Nicholson (2012) emphasised the need for the design of gamification to have a meaning for its users, hence, advocated a user-centred design approach intensifying the importance of **intrinsic rewards**, **transparency**, **users' interests over organisational goals**, and **personal customisation** towards a "meaningful gamification" design. Despite valuable insights advocated, a formal framework facilitating these insights is yet to be articulated. Simões et al. (2013) provide a work-in-progress towards a social gamification framework in an educational context, by setting the objectives and expected outcomes in future works. Gears and Braun (2013) based their study on object-oriented system analysis and design, self-determination theory (Deci and Ryan, 2000), the 16 human desires theory (Reiss, 2004), and proposed a "role-motivation-interaction" framework. This framework intends to improve a problem situation in a business context. Nevertheless, Reiss (2004) argued that the self-determination theory and the theory of 16 basic human desires are incompatible and moreover, Deterding (2015) argued that the framework does not delve into identifying appropriate design patterns and is not appropriate for designing a DM system.

The existing approaches for engineering DM are mainly to specify its operations and they are heavily based on concepts from games design. One of the languages used in the design of gamification is the game description language (GDL) (Thielscher, 2010), a modelling language for digital games. GDL is designed for game development purposes and naturally it is limited in describing motivation requirements in a business context. GDL is formally defined as a combination of *role, init, true, legal, does, next, terminal,* and *goal*, which are described in Table. 2.1. GDL focuses on *play* as a main goal to achieve, whereas, in a business context, play is a secondary goal which should help the fulfilment of other business goals and desired behaviours.

Agent Modelling Language (AML) (Červenka et al., 2004) enables designers to develop a behavioural model of the players. AML is based on Unified Modelling Language (UML) 2.0 as a base and is enhanced by Trencansky and Cervenka (2005).

AML focuses on modelling the behaviour of the agents who will be using the system and is fundamentally comprised of three main aspects – agents, resources, and the environment. The modelling of social aspects using AML relies on social structure in which the system will be applied, social behaviour in which includes the social norms and culture of the society the system intends to model, and social attitude referring to the social instances and the people who will be using the system. AML also delves into the organisational unit and models it from an external perspective as well as an internal perspective considering the social, behavioural, and psychological entities which can have an impact on the system. In addition to considering organisational units, AML provides modelling of social relationships and roles and role relationships. Social relationships refer to the interactions that various social entities may have between each other using the intended system. Roles refer to the abstraction of features, capabilities, behaviours, observations, relationships, and participations which shape an entity which can be played by individual entities. A role property is defined to represent an instance of a role that is being played by an individual. One entity can play various roles and have various role properties at a time.

AML can help in modelling the behaviour of the agents interacting with a DM system. However, it lacks technical concepts which define DM and does not consider a context which requires considering the player's role and interactions in an organisation with regards to motivation requirements, e.g., the inter-dependencies amongst stakeholders and their available strategies to achieve their motivation requirements within the business constraints and strategic interests.

Aparicio et al. (2012) proposed a method for analysis and application of gamification to increase users' motivation and engagement with their activities and tasks. This method is based on the self-determination theory (Deci and Ryan, 2000) and particularly focuses on the *autonomy* (users' will), *competence* (users' need), and *relatedness* (users' feeling of being connected to others). Four separate steps comprise

Table 2.1 Constituents of game descriptive language (Trencansky and Cervenka, 2005)

Constituent	**Definition**
role(R)	R is a player
init(F)	F holds in the initial position of the game objects
true(F)	F holds the current position of the game objects
legal(R,M)	R can do M
next(F)	F holds in the next position of the game object
terminal	the game is waiting for input from a user
goal(R, N)	R gets N points in the true(F) position

this framework; identification of the main objectives, identification of the transversal objectives, selection of game mechanics, and analysis of the effectiveness. Deterding (2015) argued that this four-step process is more fit for a "games with a purpose" (Von Ahn and Dabbish, 2008) design rather than general motivation approach as various applications of DM do not feature diverging "transversal" objectives. In addition, the authors do not provide specific explanations of the framework which can provide the designers with the necessary steps and processes for requirement elicitation in various design phases.

Herzig et al. (2013) proposed gamification modelling language *GaML*, which is designed specifically for gamification development. GaML divides the motivation requirements into basic concepts and gamification rules. The basic concepts are the atomic motivational elements based on the taxonomy proposed by Deterding et al. (2011a) and visual elements, e.g., avatar. Despite the power of GaML in formalising the design and specification of a Gamification solution, it still needs to cater for the social and organisational structure of businesses and the fact that Gamification has a strong human factor requiring a holistic socio-technical view.

With regards to the methods employed by the industry, Deterding (2015) argues that the majority of methods follow "smart gamification" proposed by Kim (2010, 2011). Smart gamification provides five key sections and asking questions with the intention of guiding the way through designing the player journey systematically.

These sections with the respective questions are provided in Table. 2.2. Deterding (2015) concludes that all of these studies, (Burke, 2014; Kapp, 2012; Kumar, 2013; Paharia, 2013; Werbach and Hunter, 2012; Zichermann, 2011), propose the following design processes:

1. Identify stakeholder goals
2. Identify end user behaviours supporting goals and quantify them
3. Use “Bartle Types” to create user profiles
4. Select game design patterns
5. Test
6. Implement
7. Monitor system performance and evolve accordingly

To complement these methods, Deterding (2015) proposed a method for gameful design which has the following steps:

1. Strategy
    (a) define target outcome and metrics
    (b) define target audience and activity
    (c) identify constraints and requirements
2. Research
    (a) translate user activity into behaviour chains
    (b) identify user needs, motivations, and hurdles
    (c) determine gameful design fit
3. Synthesis

Table 2.2 Smart gamification (Kim, 2010, 2011)

Section	**Questions**
Vision	–What is the vision for this project? –What is the key benefit? –Where is the fun?
Playstyle	–Who is playing? –Who are they playing with? –What is their primary play style? –What social actions do they find engaging?
Mastery	–What is the core activity and feedback system? –What are players optimising? –What skills are they learning? –What journey are they on? –What is driving them to keep playing? –What does it mean to play well?
Progress	–How will gamification light the way towards mastery? –How will players know how to get started? –What to do? –How will they know if they are playing well?
Engagement	–What activities and events will re-engage players throughout their life-cycle? –How do these activities leverage core social actions?

   (a) innovating mode: formulate activity-challenge-motivation
   (b) evaluating mode: evaluate skill atom and generate ideas

4. Ideation
   (a) innovating mode: brainstorming
   (b) evaluating mode: evaluate skills and generate ideas
   (c) prioritise ideas
   (d) storyboard concepts
   (e) evaluate and refine concepts

5. Iterative prototyping

Although this method complements other available frameworks and methods and enables a more detailed design of DM, there is still a need for clarification of the precise steps and guidelines for each phase. In addition, despite considering the need for a human centred design approach, it is not yet clear how this can be achieved. Also, the socio-technical view of the system is still missing in this method, failing to understand structural and organisational relations which may be available between end-users in a workplace.

2.2.2 Serious Games

The term serious games refers to the facilitation of fully-fledged games in pursuing objectives other than entertainment (Susi et al., 2007). It overlaps with several other domains, such as e-learning, edutainment, and game-based learning. E-learning can be defined as the effective usage of multimedia technologies in enhancing the learners' experience (Hodson et al., 2001). Edutainment (Peck, 1988) is another term which refers to any type of education that involves entertainment. It is not necessarily through digital media, however, usually an electronic device is involved. There have been controversies with regards to the use of edutainment through software and games since the resulting games were often not engaging (Van Eck, 2006). Another overlapping domain is game-based learning, defined as using the capabilities of computer games in motivating and engaging end-users for specific purposes, mainly training (Corti, 2006). Corti (2006) consider game-based learning and serious games to be the same concept, providing a potential of improving knowledge and skills through the engaging nature of games. However, there are differences between entertainment games and serious games. Beside containing art, storyline, and complex algorithms, serious games have *pedagogy* which entertainment games lack and adds to the seriousness to the games (Zyda, 2005).

Applications

Serious games can be applied to various areas with different purposes. Michael and Chen (2005) categorises the application areas of serious games as *military games, government games, educational games, corporate games,* and *healthcare games*.

Military: The use of serious games is in the interest of military training as it provides a low-cost simulation of various situations that could inflict possible harm to the learners if trained in close to real situations. The use of serious games can provide the trainers with a flexible and dynamic environment which can cover and simulate a vast spectrum of dangerous combat situations repeatedly without exposing harm to the trainees.

Government games: Governments may find the use of serious games beneficial in various areas, e.g., disease outbreaks, health care policy issues, bio-hazards, dealing with terrorist attacks, city planning, traffic control, fire-fighting, and budget control (Michael and Chen, 2005; Squire and Jenkins, 2003). Susi et al. (2007) emphasised that serious games provide repeatability of the same scenario which gives the opportunity for learners to check how various variables could have an impact on the same situation. Moreover, they note that serious games provide an ability to choose the degree of severity with very low cost in resources, such as a firefighting simulation.

Corporate games: Corporates could benefit from serious games in various areas: *human skills, job-related skills, communication skills*, and *strategy skills* (Michael and Chen, 2005). Staff training for corporations is challenging for corporations for several reasons, including boring learning material, difficult or complex learning objectives, and conflicting staff timetables (Michael and Chen, 2005; Prensky, 2001). Serious games try to battle these problems by adding entertainment to the learning process, providing step-by-step guidance, and being accessible at any time.

Health-care games: Serious games can have multiple areas of application in health-care. (Michael and Chen, 2005) lists a number of these application areas as follows:

- **Physical fitness:** Serious games can enhance the fitness level of their end-users by adding fun to the healthy activities, encouraging users to start or maintain their health programs.
- **Self-care education:** That is the use of serious games in promoting educational information amongst the end-users, aiming at raising awareness and teaching health-related information.
- **Distraction therapy:** Serious games can be utilised as an element of distraction, especially in children, to help deal with the pain, to distract during uncomfortable treatments, or to ease the anxiety prior to medical procedures (Cromley, 2006; Michael and Chen, 2005).

- **Recovery and rehabilitation:** Serious games can help patients to perform physical activities required for their recovery with more motivation.

- **Training for medical experts:** Serious games are not limited to helping the patients. They can be designed to help training medical experts learn activities such as surgery.

- **Diagnosis and treatment of mental health problems:** Serious games can be designed in a way that provides medical experts with information which can be used for diagnostic purposes. End-user will be asked to play the game and perform the tasks, the choices that they make and the reactions they may have while playing the game can enrich the information required for the diagnosis of several mental illnesses such as attention deficit hyperactivity disorder (Susi et al., 2007).

- **Cognitive functioning:** Serious games can be used as a mean for cognitive exercises, such as memory training or enhancing the analytical and strategic skills (Mitchell and Savill-Smith, 2004).

Serious games are designed with an educational mindset and are fit for training purposes only. It can help in lowering the costs, reducing the dangers, making training entertaining and training times flexible. However, the domain of DM does not only aim at increasing motivation in an educational setting. DM mainly aims at increasing the will of people in performing their tasks, without changing their tasks into fully-fledged games, which may be in contrast to many organisational points of views. Therefore, the concept of serious games cannot provide a holistic definition and conceptualisation of DM, e.g., in a non-educational business context and therefore, further investigation is required.

2.2.3 Human-based Computation Games or Games with a Purpose

Human-based computation games or games with a purpose (GWAP) could be considered a combination of crowdsourcing and games. They intend to use the desire of people for entertainment and perform tasks which could require low cognitive load for humans, but require extensive computational load for computers, such as building smart cities (Celino et al., 2012) or object identification in images (Von Ahn et al., 2006).

There exist various tasks which humans find trivial and easy to perform, where even the most sophisticated computer algorithms find challenging. For example, object identification in an image (Von Ahn et al., 2006) requires little intellectual input from humans but is very challenging for computers to perform accurately. There have been several attempts at utilising the power of the crowd and resolving the problem. An instance of this is Amazon's Mechanical Turk system (www.mturk.com/mturk/welcome), which breaks the computational tasks into smaller chunks and delegates them to individuals willing to perform for a small amount of pay. One of the challenges, however, is the quality of the input which comes from the crowd as people may just agree to solve a problem merely for the sake of earning money. To increase the quality of the contribution of the humans, GWAPs aim at encouraging humans to perform tasks they find trivial which are still tough to perform even with very sophisticated computer algorithms by embedding them into fully-fledged games (Von Ahn and Dabbish, 2008).

GWAPs make use of the desire of humans to play, and provide a playful environment which encourages individuals to play, which as a result will solve the problem. It is important to know that the main objective of users of GWAPs is to play and they may not find the actual objective of the games (to solve a difficult problem for computers) to be appealing. Therefore, it requires purposeful design and adequate thinking to create games which ensure the quality of input from users and also sustain their engagement with the game for longer person-hours. Von Ahn and Dabbish (2008) provide three templates to design GWAPs which can increase the quality of input from players and keep them engaged with the system by keeping the fun element in place. These three templates are *output-agreement games, inversion-problem games*, and *input-agreement games* which are describe in the following sub-sections:

Output-agreement Games

Output-agreement games need two random players from the pool of available players and ask them to produce input on the same task. They are not allowed to communicate with each other or see the provided answers from the other player. The winning point is achieved only when they both produce the same results. This can verify the answer from the crowd by ensuring the same given answer from two various independent sources.

Inversion-problem Games

Inversion-problem games need two random players from the pool of available players, and each has separate responsibility; one is assigned to be the "describer", and the other is assigned to be the "guesser". In this game, the *describer* is given an input and is asked to describe it to the other player. The guesser should be able to make an input the same as the original input so that both can win the game.

Input-agreement Games

Input-agreement games need two random players from the pool of available players, and the players are given inputs which could be similar or different. The players are asked to describe the input to the other player so they can figure whether they are given the same input or different ones. The winning point is given to the players if they successfully find that they were given same inputs or different ones.

In general, GWAPs may show successful outcomes for encouraging users to perform the designated tasks. However, it is arguable that they are not suitable for all tasks and environments. Various reasons could exist for this argument, such as focusing on designing a game, rather than motivating users to be engaged with the actual tasks. GWAPs may be useful for trivial tasks, which do not require high intellectual input from its end-users. Nevertheless, it is not intended for more sophisticated tasks, and its implementation may not be in the interest of many environments, shifting the focus of their users from the actual work and tasks into a game. In addition, considering the concept of GWAP and gamification, GWAP may fall into the definition of gamification considering that "human computation" is not a gaming context and adding mechanics and elements used in games are for a purpose other than games which create a gamification tool. Nonetheless, this argument may cause controversy and raise discussions on whether a fully-fledged game is a gamification, although the ultimate goal other than entertainment is pursued. This distinction between GWAP and gamification is yet to be defined, and the lines are to be drawn.

2.2.4 Persuasive Technology

According to Fogg (2002a), persuasive technology tools aim at easing behavioural change through interactive products. Fogg's Behavioural Model (FBM), consists of seven types of persuasive tools: reduction, tunnelling, tailoring, conditioning, suggestion, surveillance, and self-monitoring. These tools are explained in more detail as follows:

Reduction

Fogg defines reduction as "technologies [which] make target behaviours easier by reducing a complex activity to a few simple steps (or ideally, to a single step)" (Fogg, 2002b). As discussed in Khaled et al. (2005), reduction as a persuasive tool may increase the benefit/cost ratio, which may increase the chance of people repeating a behaviour. The authors suggest that this simplification of the tasks will cause an increase in users' self-efficacy and also facilitate goal achievement in individuals.

Tunnelling

Tunnelling (Fogg, 2002c) refers to leading the users through pre-defined structures of events, which has to be performed step-by-step. This is widely used in DM, e.g., by breaking down the bigger tasks into smaller chunks. The accomplishment of each chunk gives users points and reflects their progress through a progress bar to inform them about the amount of the job performed and the amount which is due to be performed.

Tailoring

Tailoring in Fogg's persuasive model (Fogg, 2002d) refers to the use of technology to provide personally relevant information to the system users, with the aim of encouraging them to pursue/avoid certain behaviours. Since DM captures a considerable amount of information with regards to the context a user resides in, it enables the tracking user behaviour and activities and tailors messages or information according to their exact performance. For instance, a performance monitoring mechanism can compare the current performance of an employee and generate assessment reports for each individual by comparing their performance with a pre-defined acceptable margin by the managers. This allows employees to understand whether they need more effort in meeting the organisation's working standards and make decisions accordingly, avoiding loss of interest in yearly appraisals.

Suggestion

Suggestion (Fogg, 2002e) is another persuasive technology tool that is intervening with users' activities at the right time. The aim of suggestion is to remind users to perform certain behaviours, and this is possible through DM by monitoring the current conduct of the users and remind them of appropriate actions when necessary. An instance of this technology would be encouraging employees to have periodical breaks from digital display systems and perform other tasks which do not require a digital display. In this case, the employees' usage of the digital display systems is measurable and can be tested against standard healthy usage times, and remind employees with pop-up messages to perform other tasks which require non-digital display systems.

Self-monitoring and Surveillance

DM relies heavily on the information from the performance of users. All the relevant information are monitored and stored in the system and DM will make decisions based on this stored information. The captured information can be used by managers to monitor the performance of their employees, or by the users themselves to track their own performance. These characteristics could be mapped to the self-monitoring and surveillance persuasive tools in Fogg's model. In addition, availability of captured information tracked performance or achievements using gamification to peers in an environment could relate to Fogg's idea of social pressure or peer pressure. Although this idea seems to be used as a persuasive tool, it could be argued that the presence of peer pressure in the environment could cause conflict amongst peers

(Zeynep et al., 2011). It also can create ethical issues related to privacy of the users (Fogg, 2002f).

Conditioning

In addition to surveillance and self-monitoring, information captured by DM can be used to give virtual goods, e.g., rewards, badges, unlocking achievements, or avatars. This feature of DM can be mapped to the conditioning persuasive tool. Conditioning (Fogg, 2002g) refers to making use of "operant conditioning" to persuade humans to perform the target behaviour. Mainly conditioning could be related to the concept of rewards in games and gamification. When the target behaviour is met, the reward is achieved. However, operant conditioning means that there could be positive conditioning, such as rewarding for accomplishing the target behaviour, as well as negative conditioning, conveying there could be a punishment for not achieving certain behaviours.

2.3 Motivation as a Requirements Engineering Problem

In the field of requirements engineering, systems are generally considered as socio-technical systems (STS) consisting of various inter-dependent social and technical actors. In a business context, it is in the interest of organisations to keep their employees motivated to reach a high level of business goal achievement. However, keeping employees motivated is a challenging task and requires careful considerations. As discussed earlier, motivation has had the considerable attention of scholars in the field of psychology, and as a result, there are various models and methods which try to define and understand the concept of motivation. In a business context, despite the advantages that motivation can bring, it is not yet a priority for organisations, only complementing current business goals and activities, helping to achieve functional and non-functional requirement in the environment. This complementary role of motivation in the field of requirements engineering means that motivation is not seen as a first class requirement of organisations to be fulfilled, but a supplementary requirement, helping other functional and non-functional requirements to be accomplished (Shahri et al., 2015).

With the advances seen in the growth of digital means and device capabilities, it is now possible to implement and deliver motivation theories and methods to end-users via the digital medium, e.g., computer systems in places of work or personal smartphones outside of work or for mobile use. It is understandable that motivation involves a broad range of physiological and psychological needs and digital means may not be able to actually deliver motivating factors (e.g., food),but they can provide the means to acquire or access them (e.g., through money or enabling delivery of food). Also, a considerable subset of psychological needs can be fulfilled by the use of digital motivation, and some of the physiological needs may be even enhanced by the use of software, e.g., sleep pattern analytic programs, aiding in finding a suitable sleeping pattern for end-users.

It is noteworthy that digitising motivation brings new aspects which were not available in the classic implementation of motivation methods and models. These new aspects are, amongst many others, the ability to collect a large amount of data and provide analytical capabilities about human behaviour. In addition, the use of digital motivation can provide more frequent data collection and communication between the facilitators and the end-users. This new features of DM mean that its introduction to new environments may affect the current requirements of stakeholders, or even cause the creation of new requirements. A sensible DM design approach needs to cater for any impact the exposure of DM to the environment may have, and detect any new requirement which may emerge.

2.4 Approaches to Engineering Motivation

Considering the reviewed facets and peculiarities in the concept of DM and with the very fine line between other similar concepts (e.g., serious games, gamification, and GWAPS), it is necessary to conduct a holistic investigation on motivation in its digital form. This investigation will aim at finding common ground for DM which defines the line between DM and other similar concepts and provides a systematic approach towards its design and implementation.

The literature still lacks a fully systematic approach for introducing digital motivation to a business context to aid in the design from the starting point to the final phase (Seaborn and Fels, 2015) and this gap has caused many of the designs to follow an ad-hoc approach, which is prone to relying on the knowledge and experience of the designers. Moreover, not following a systematic approach means that evaluating the success rate of the design of digital motivation is a very challenging task, as it is not clear which metrics should be used to measure the success or failure of conception. Lack of a success measurement benchmark can cause a failure in improving the design of DM as "what cannot be measured, cannot be improved".

2.4.1 Systems Analysis Approaches for Socio-technical Systems

A socio-technical design tries to create a balance between social and technical aspects of an STS. The changes in industries are inevitable with advances in technology, and companies are moving from hierarchical and centralised to networks, and de-centralised structures and these new changes may lead to various problems if not controlled properly (Castells, 2011). For instance, the network approach can result in duplication of resources and destructive competition amongst some units in the network. In addition, management issues may occur as well, such as performance evaluation and decision-making in this situations (Dickens, 1999). Various system analysis approaches try to address the problems in the design of STSs. Amongst the well-known ones are user-centred design (Norman and Draper, 1986) and Mumford's ETHICS.

User Centred Design

In many approaches in system design, the main focus is on fulfilling the business goals and technical features of the software systems. This focus will lead to the elimination of the main part of systems – the end users. User-centred design (UCD) was proposed to involve the end users in the design process (Norman, 1988). UCD is a multi-stage problem-solving approach targeting to address the needs and limitations of end-users of a product, service, or process. The use of UCD can help software designers to fulfil the goals of a product engineered for their users. UCD tries to involve users in the design process and collect their requirements, design prototypes based on the findings from users, and validate the findings by asking for feedback on the prototype directly from the users. As Sharp et al. (2007) suggest, there are various ways to involve users to elicit and refine their requirements:

- Background interviews and questionnaires
- Sequences of work interviews and questionnaires
- Focus groups
- On-site observations
- Role playing, walk-throughs, and simulations
- Usability testing
- Interviews and questionnaires

Involving the users as mentioned, will help collect data related to the requirements and expectations of the users, and evaluate the design of alternatives, prototypes, and

Table 2.3 Involving the users, techniques, purposes, and stages (Abras et al., 2004)

Technique	**Purpose**	**Stage of the Design Cycle**
Background interviews and questionnaires	Initial requirements elicitation	Early stages of the design project
Sequence of work interviews and questionnaires	Requirements elicitation for the sequence of work to be performed with the artefact	Early in the design cycle
Focus groups	Involves wide range of stakeholders for discussions	Early in the design cycle
On-site observation	Data collection with regards to the environment	Early in the design cycle
Role playing, walkthroughs, and simulations	Evaluation of alternative designs	Early and mid-points in the design cycle
Usability testing	Quantitative research related to measurable usability	Final stage of the design cycle
Interviews and questionnaire	Qualitative research related to user satisfaction	Final stage of the design

the final artefact through background interviews and questionnaires. The second step can help in collecting data related to the sequence of work to be performed with the artefact. Focus groups can assist in gathering a broad range of stakeholders and discussing issues and requirements. On-site observation can help in collecting information regarding the environment that the product will be used. Finally, role playing, walkthroughs and simulations can assist in the evaluation of alternative designs and gain additional information regarding the users' needs and expectations (Abras et al., 2004).

2.4.2 Archetypes and Personas

Developing personas should aid software designers to consider the requirements of the actual users in the design process (Pruitt and Grudin, 2003) and this can help achieving a software system that is closer to the requirements, needs, and preferences of the actual end-users. There are several benefits to the use of personas as discussed in (Canossa and Drachen, 2009; Miaskiewicz and Kozar, 2011; Nielsen, 2002; Seffah et al., 2009):

- Instead of abstract user information, software engineers will relate to personas easier as they are given life
- Software engineers and software designers can communicate with each other in a fast and effective manner through the use of personas
- Personas will make the design closer to the actual end-users' requirements, rather than what is convenient for the stakeholders
- Personas will enable designers to view the system from the lens of other users, and not just themselves
- By creating a subset of users, designers will be able to focus more on satisfying the requirements of each user type
- Personas can aid the validation of the software by reviewing the needs and requirements of personas against the behaviour of the software system
- Personas can inspire the designers in the design process (see Fig. 2.3)

These benefits resemble the potential benefits of developing and using personas in the design process of DM as a solution to tackle the challenge of satisfying the requirements of end users. Personas can help software designers and software engineers by creating a channel of communication between the actual users and the designers. This communication channel can contribute to achieving a DM that is more acceptable by users from the social and psychological well-being aspects.

2.4.3 Shaping Archetypes and Personas

Using personas in the design of DM can be a helpful way of having a closer design to the actual requirements of its end-users. However, developing a representative set

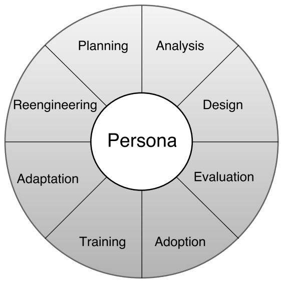


Fig. 2.3 Involvement of personas in software engineering (Seffah et al., 2009)

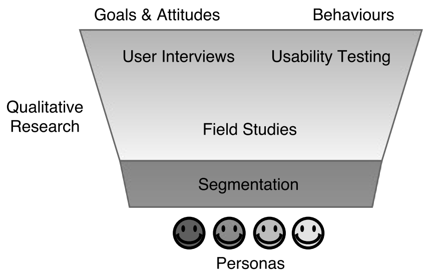


Fig. 2.4 Persona creation approach (Mulder and Yaar, 2006)

of personas is a challenging task on its own, and there is no one-size-fits-all solution for creating personas (Mulder and Yaar, 2006). As Mulder and Yaar (2006) state, widely used traditional approach for designing personas follows the following steps (as illustrated in Fig. 2.4):

- **Qualitative research:** This refers to various types of studies. Namely, interviewing with end users, that is usually between 10 to 20 people, usability testing, which involves observing users behaviour, or field studies, that is observing users in their native environment which has the benefit of asking about users goals and attitudes in a real-world case.

- **Segmentation:** Creating groups of users based on the gathered data from the qualitative research is performed mainly with the goal of finding patterns in users behaviours or requirements and assign them to a similar group. Typically, each group has a different attitude, goal, and/or behaviour in comparison with other groups.

- **Creating personas:** Each segmented type of users can be transformed into a persona by giving life to them. This transformation is performed by supplying them with names, age, gender, picture, and scenarios.

One way to develop a representative set of personas is to elicit qualitative and quantitative data about the users and turn them into understandable fictional characters that can help design a certain product (Spool, 2007). There are several factors that define how personas should be designed (Mulder and Yaar, 2006):

- Methods used and expenses they need (money, time, resources), in order to elicit the information,
- how the created personas will be used, and
- final users of personas and their requirements

2.4.4 Mumford's ETHICS approach

Mumford's ETHICS is a participatory method that focuses mainly on the humans and their relations with the procedures in the computer system. The ETHICS stands for *Effective Technical and Human Implementation of Computer-based System.* Creation of ETHICS was based on the failures of various traditional approaches towards designing computer systems (Davis et al., 1992). ETHICS has gone through various iterations, and Leitch and Warren (2010) provide a review of the various available versions of it. According to Leitch and Warren (2010), ETHICS considers three levels of participation for involving users in the design process:

1. Consultative – this refers to the time where a committee is used to implement the changes and the users will be notified by the changes and the effects they will have on them

2. Representative – this is when a cross selection of those users that are going to be affected by the changes are selected and involved in the design process.

3. Consensus – this is when all the affected users and stakeholders are involved in the design process Mumford's ETHICS had 15 stages from analysis of the current system, involving users in design process, to evaluating the final artefact. A number of criticisms, also noted in Avison and Fitzgerald (2003), can be found in the literature and are as follows:

    - Unskilled users cannot design
    - Management will not accept it
    - It removes the right to manage from managers
    - It is slow and costly in staff time and effort

In order to address the expressed criticisms, Mumford proposed a newer version of ETHICS, QUICKethics (Mumford, 1993), which is in five main stages:

- Describe the work mission, key tasks, critical success factors and most serious problems.
- Describe the objectives, critical success factors, major problem, day-today activities, and potentials for future developments associated with each of the key tasks.
- Describe the information needs associated with these tasks in order to achieve the objectives, attain critical success factors and avoid major problems, as well as monitoring performance and understanding future developments.
- Prioritise these information needs according to which are essential and which merely desirable, and which are quantitative and which are qualitative.
- Work with others to establish an information model so that information flows through the organisation to those who require it.

2.4.5 Goal Oriented Requirement Engineering

Software systems consist of programs, configuration files, system documents, and user documents. Software may be developed as either a generic product, targeting open markets or a customised product developed for specific stakeholders (Sommerville, 2010). Regardless of the product type, software systems aim at fulfilling the stakeholders' requirements. Requirements engineering (RE) is a set of processes, which tries to identify the stakeholders and their requirements. As Nuseibeh and Easterbrook (2000) indicate, RE consists of five core activities: eliciting requirements, modelling and analysing requirements, communicating requirements, and evolving requirements. In addition, Van Lamsweerde (2000) consider aspects such as domain analysis, specification analysis, and documentation, as primary RE activities.

Modelling in RE has two phases, early requirements phase that models the existing system/organisation (system-as-is) and late requirements phase, which tries to model possible alternatives for the system-to-be (Lapouchnian, 2005). Concepts that RE offers for modelling are actors (agents, positions, or roles) and social dependencies amongst the actors in the STS (goals, soft-goals, tasks, and resources) (Castro et al., 2002). These requirements are in two-folds; functional requirements (FR) specifying the services and functions that the system provides, and non-functional requirements (NFR) representing the quality or properties of the system. The quality based nature of NFRs makes them difficult to express and hard to measure (Lapouchnian, 2005).

From RE's perspective, motivation can be seen as an NFR for the environment it is intended to be applied. However, since motivation is not the main goal of organisations, it can be considered as a supplementary requirement, in which complements other available functional and non-functional requirements.

RE's constant interaction with social factors, i.e., stakeholders, makes a number of strains natural for the process (Nuseibeh and Easterbrook, 2000). Namely, various stakeholders of a software system may have conflicting requirements, their requirements may not be clearly known, or they might be difficult to articulate. Stakeholders' satisfaction of the system is vital to the designers. RE enables satisfaction measurement by identifying the stakeholders and their requirements and determines the fulfilment degree of each requirement. A critical success factor in the development of information systems is the alignment of the final software product with the requirements (Pastor, 2017). Eliciting the requirements at a pre-design phase enables software developers to identify desired software behaviours and implement them to increase stakeholders' degree of satisfaction. Moreover, another significant obstacle for software engineers is the alteration of requirements over the course of time. These may be caused by changes in various aspects of the system, i.e., the environment, technology, or the perspective of stakeholders. Therefore, software evolution is necessary and monitoring the system for the need for alterations is inevitable.

2.4.6 Adaptive Systems

Nowadays, software systems demand innovative approaches for building, running, and managing to be able to catch up with the integration of technology, fast growth of information, and constant evolution, from software-intensive systems to ultra-large-scale systems (Northrop et al., 2006) and requirement engineering is no exception. Therefore, a self-adaptive system seems to be the solution to this problem by having more versatile, flexible, resilient, dependable, robust, energy-efficient, recoverable, customisable, configurable, and self-optimising abilities that enable the system to adapt itself congruously to changing operational contexts, environments or system characteristics (Cheng et al., 2009).

Designing and implementing a cost-effective and predictable self-adaptive system is a major challenge for software engineers. Traditionally, a bottom-up or a top-down approach is used for designing a self-adaptive system. However, new theories need to be added to achieve a well-designed self-adaptive system. An essential entity for self-adaptive systems is feedback loops from control engineering, which enables monitoring of the system, evaluating the current state, and acting accordingly. (Brun et al., 2009)

2.4.7 Control Theory

The idea of social sensing sounds promising, however, according to Almaliki et al. (2014), one major obstacle is to elicit feedback from users. Their study showed that users are reluctant to give their feedback to the system. Behavioural change theories can help users to provide their feedback to the system. Psychologists have proposed numerous theories to detect/predict the need for behavioural changes. Examples of these theories are the theory of planned behaviour (TPB) (Ajzen, 1991), the health belief model (Becker, 1974), and control theory (Carver and Scheier, 1982a).

Control theory has been widely used in dynamical systems and requirement engineering, e.g., adaptation and evolution, to collect and analyse feedback, and act upon with a congruous operation to keep the system-as-a-whole functioning at the desired performance level. Control theory, as illustrated in Figure 2.5, facilitates a reference point, which is the desired output, sensors, which monitor and gather the feedback, and the controller, which compares the output with the reference point. The delta between the output and the reference point is considered as the error signal, which indicates whether there is a need for a change in systems' behaviours.

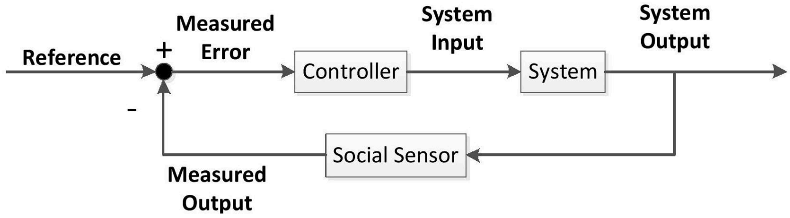


Fig. 2.5 Control theory

2.4.8 Social Adaptation

Although self-adaptive systems are effective and well established, they are only effective where the attributes are observable utilising technological monitors and sensors. When facing attributes such as users' perception of software behaviour, they fail to adapt the system accordingly to the users' opinions. Systems need to be able to elicit users' perception, analyse, and act congruously. As a solution to this problem, Ali et al. (2011) proposed social sensing, that is the use of software systems' users as monitors.

Social sensing tries to exploit the presence of users in STSs to provide the system with information, which the system cannot monitor on it's own. The users provide the system with the information it needs to make decisions, and the system will respond accordingly. However, social sensing focuses on the problem domain (e.g., requirements, context, quality, or validity), not the technical solution domain (e.g., bugs or errors). This specific focus on the problem domain makes social sensing ideal for solving problems in the field of requirements engineering, where the system needs to capture users' perception on the current system behaviours, available alternatives, and detect the need for introducing a new alternative.

The use of social adaptation in the context of this research could help in identifying the need for a change in the system and suggesting the more appropriate software-based motivation settings for the users. According to Ali et al. (2011), social sensing tries to perform with four contributions: context values, quality and validity assessment, context attributes identification, and quality attributes identification.

Context values: when the suggested settings of software-based motivation to the environment do not match with the context it is being applied to, users can provide the system with this incompatibility. The system by itself is unable to detect this inconsistency. However, users perceive this incompatibility naturally, and therefore, they can provide the system with this information.

Quality and validity assessment: the validity and quality attribute of software-based motivation settings are not always known and definite to the designers while designing the system. There is always the risk of making mistakes, and it is not possible to capture the degree of quality and validity of introduced settings with current technological sensors. Social sensing provides the system by this information through involving the users in the run-time and eliciting their feedback.

Context attributes identification: the context attributes of an STS may change over the course of time with changes in technology, changes in the staff, or even changes in the users' characteristics. Moreover, the designers might have identified the context attributes wrongly at first place. Social sensing provides the users to act as designers and determine any changes in the context attributes or any mistakes in the identification of the attributes and notify the system through their feedback.

Quality attributes identification: similarly, users' opinion and perception about the quality and validity of a software-based motivation could change over the course of time, or even they might have been identified wrongly at first place. Therefore, social sensing provides the ability to determine these mistakes through users' feedback and provide them with a relevant alternative.

2.5 Requirements Engineering Conceptual Modelling

Requirements engineering conceptual modelling aims at improving the quality of the software production processes, which ultimately results in a higher quality software product. This quality improvement is usually achieved through clear specification of the systems' requirements, and decomposing them into specific conceptual constituents which shape the desired system-to-be. This conceptual approach towards software production processes provides predictability and improves productivity. (Insfrán et al., 2002)

A well specified software engineering approach should be able to draw a distinctive line between its various steps (Pastor et al., 2001). Rolland (1998) specified four problems which their resolution could result in a better software engineering approach:

- Contradictions, ambiguities, incompleteness, and mixed levels of abstractions
- Incomplete understating of the problem space
- Lack of computer aided software engineering tools
- Lack of systematic and structured approaches

Pastor et al. (2001) advocated the move from traditional software systems engineering towards advanced requirements engineering to overcome these four issues, stating that there should be a clear and distinct separation between the problem space and the solution space as well as clear determination of the methods which will convert the conceptual models into the final software artefact.

For systems with high complexity, it is not advised to derive the formal system specification immediately from the requirements provided by the client (Regnell et al., 1995). However, the literature lacks rigorous systematic approaches for the design and development of digital motivation. Currently, there is a heavy reliance on ad-hoc designs and the knowledge and expertise of the designers. Despite various successful instances of these ad-hoc designs (Hamari et al., 2014), it is arguable that these types of designs lack engineering processes and lack predictability and rigour. Hence, the requirements engineering conceptual modelling and as Insfrán et al. (2002) advocate, the utilisation of requirements modelling and requirements analysis process can eliminate the uncertainty and provide rigorous systematic requirements engineering.

2.6 Conclusion

This chapter began by providing an overview of motivation theories in the field of psychology and moving towards applications and systems that use a digital form of motivation. It was stated that various features of digitalising motivation, e.g., ability to store a vast amount of data and automated analysis, makes digital motivation different from classic forms of motivation. Various forms of digital motivation have been identified, and the need for establishing a common ground for the definition and concepts comprising digital motivation was proposed. Moreover, various frameworks, guidelines, and design paths relating to the field of digital motivation have been identified and reviewed. As a result, this research advocates further investigation towards a systematic approach for designing and implementing digital motivation. The systematic approach will enable conceptualisation of digital motivation and allow for analysis of a design for identification of issues and provide resolution opportunities.

Software engineering concepts, tools, and approaches were discussed which enlightened this research with possible solutions to address the problem and result in the intended systematic approach.

Chapter 3

Research Methodology

This chapter discusses the principles and reasoning behind the methodologies and study designs adopted by this research and examines alternative methodological options available. Also, this section provides a discussion on potential research paradigms fit for the purpose of this research and identifies and describes the one which is the most appropriate and selected.

3.1 Research Paradigms

Research in computer science can be divided into two broad groups – empirical and non-empirical studies. Empirical studies perform investigations via experiments, observations, or perceived experiences. The gained evidence in an empirical study can be analysed through qualitative or quantitative methods. On the other hand, non-empirical studies can be defined as the use of secondary data which are often used for the purpose of shaping theories and ideas. It should be noted that if empirical and non-empirical studies are two ends of a spectrum, many research studies fall in between these two, e.g., quasi-experimental. Empirical studies in computer science are widely used, and the following discusses various types of it – qualitative, quantitative, and mixed methods.

Qualitative research is often used to study social or human problems, which involve the collection of data from participants allowing questions to emerge and inductive data analysis moves from sub-themes towards more general themes. In qualitative research, the interpretation of the data is the responsibility of the researchers performing the study (Fink, 2000).

On the other hand, quantitative research is less subjective, tests theories objectively through examining the relationship amongst variables. The variable can be measured with numbers, allowing data analysis with statistical procedures. Quantitative research is mainly deductive, trying to form a particular idea from a general theme (Creswell, 2013).

However, there are various circumstances where the mere use of the quantitative method or qualitative method would not suffice. Hence, researchers use both and follow a mixed methods approach. A mixed methods research involves a particular philosophical assumption, alongside concurrent usage of qualitative and quantitative approaches, arguably making it more reliable and insightful than just data collection and analysis using the summation of findings using each approach individually (Creswell, 2013).

Various research philosophies and research paradigms try to form clusters and packages of research methodologies, providing distinctive characteristics which fit specific types of research and guide research from its commencement to its completion. Four of these paradigms which are relevant to this research are positivism, constructivism, participatory, and pragmatism which will now be evaluated.

3.1.1 Positivist Paradigm

3.1.2 Positivist Paradigm

Post-positivism is similar to the quantitative form of research, trying to contribute to knowledge by direct or indirect observation and measurement of the research objectives. Therefore, developing numeric measurements from the observations is a key aspect of post-positivist philosophy. This philosophy believes that two individual and independent researchers should achieve the same results if they conduct exactly the same research procedures (Trochim and Donnelly, 2001). This expectation is to acknowledge that there is a possibility of bias when researchers analyse their observations which are subject to human judgement. Hence, the extraction of reality and knowledge from human observation is imperfect and probabilistic (Robson and McCartan, 2016).

3.1.3 Constructivist Paradigm

Constructivism is more similar to the qualitative form of research which aims at investigating the complex views humans may have on the subject of the study, believing that humans live and work subjectively, based on their perception and understanding of the world. This subjectivity requires descriptions coming from people in their own words, which can be collected individually or in group discussions. This type of research usually aims at addressing the interactions of individuals within their context . (Johnson and Onwuegbuzie, 2004)

3.1.4 Participatory Paradigm

Participatory or advocacy paradigm, amongst other things, provides a voice for the marginalised people and enables them to present their views on the subject. The marginalising of people can occur in cases that important aspects for a group of people are not considered in the research, ignoring their point of view. This negligence can lead to inequality, oppression, domination, suppression, and alienation of some people. In the participatory paradigm, researchers involve the humans in the early stages of the study, starting with one or two focal points. This involvement allows the participants to contribute to the design or research in collaboration with other participants. The participants may design questions, collect data, analyse information, or read the rewards of the research. (Spinuzzi, 2005)

3.1.5 Pragmatic Paradigm

The pragmatic paradigm provides flexibility on choosing the most effective research methods for solving the problem. There are various research problems which require a mixture of methods to be adopted. Pragmatism provides such flexibility and gives the researchers the freedom to break the problem into smaller projects and choose an appropriate method for each part of the problem. Pragmatism often uses the mixed methods approach to research and does not consider an absolute single method as a solution. (Creswell et al., 2003)

3.1.6 Which Paradigm to Choose?

The characteristics and complexity of the research problem require breaking down the problem into smaller projects and addressing them individually. This division can separate the concerns and allow the researcher to focus on specific aspects of each problem at a time. Ultimately, the findings of each smaller problem will collectively shape the solution to the main problem. Each of the smaller projects may require adopting empirical techniques or non-empirical techniques. Moreover, the empirical techniques may demand a qualitative or quantitative approach.

The research problem of this study requires investigations on social and technical aspects of BISs. Hence, this research relies on subjective opinions of people in various contextual situations which can result in multiple and complex views of users on the subject. There is the danger of neglecting a proportion of people while dealing with the human perception of a system, which can lead to marginalising groups of people in the system. It is in the interest of this research to avoid such issues, facilitating qualitative research methods, and constructive and participatory paradigms. Additionally, the technical aspect of the research problem requires non-empirical and quantitative studies and post-positivist paradigm. Besides, to address technical issues in this research, there is a need for non-empirical techniques. As a result, this research follows a mixed methods approach and a pragmatic philosophy and paradigm which provides this study with the freedom to choose the appropriate method of study at a time.

3.2 Mixed Methods Research Options

Designing a mixed methods research is inherently challenging as it has the challenges of both qualitative and quantitative research, in addition to challenges that emerge when the two research types are mixed. Although it is difficult to create a one-size-fits-all research design for mixed methods approach studies, there exist fundamental principles that can navigate researchers: using a fixed/emergent design; identifying a design approach to use; matching designs to the problem, purpose, and questions of the study; and being explicit about the reason for using mixed methods. These principles are described in the following.

3.2.1 Fixed and/or Emergent Design

Mixed methods designs can have a fixed design, which means the researchers plan the qualitative and quantitative methods in advance and the study is followed as it is planned. On the other hand, emergent mixed methods approach occurs when due to inadequate findings of a conducted research method, a new qualitative or quantitative approach is added to the study.

3.2.2 Design Approach

Researchers may find different approaches suitable to design a mixed methods study. There are several design approaches which fall into two categories: typology-based approaches and dynamic approaches.

Typology-based Approach

A typology-based approach towards a mixed methods research design advocates the classification of various designs into groups which can then map a problem and research question to each of these categories. This grouping helps to identify a mixed methods design fit for a specific type of problem, e.g., Tashakkori and Teddlie (1998) consider the following for social and behavioural research: *multi-strand designs, concurrent mixed designs, sequential mixed designs, multi-strand conversion mixed designs,* or *fully integrated mixed model design*

Dynamic Approach

Dynamic approaches consider multiple components of research that inter-relate with each other rather than focusing on selecting a design from an existing typology. Hall and Howard (2008) describe a dynamic approach to mixed methods research design, called synergistic approach, which combines a typology-based approach with a systemic approach. This combination can have a greater impact than the sum of each component alone. The core principles of the synergistic approach are the concept of synergy, the position of equal value, the ideology of difference, and the relationship between the researchers and the study design.

Match the Design to Research Problem, Purpose, and Question

Depending on the research problem, purpose, and questions, a different mixed methods design may be appropriate. Researchers need to conduct careful investigations prior to the design of the study to find the proper design for the research problem, purpose, and question. A research problem may require multiple phases of research, each requiring a different plan and design.

Reasons for Using Mixed Methods

Mixing research methods is challenging, and it is advised to adopt only when there is a specific reason for it (Creswell, 2013). There are various discussions about when and why mixed methods design should be used. Greene et al. (1989) have identified five main reasons for using mixed methods design – triangulation, complementarity, development, initiation, and expansion. These reasons are summarised in Table 3.1.

Table 3.1 Summary of the reasons to use mixed-methods approach

Reason for mixed method design	**Summary**
Triangulation	seeks convergence, corroboration, and correspondence of results from the different methods
Complementarity	seeks elaboration, enhancement, illustration, and clarification of the results from one method with the results from the other method
Development	seeks to use the results from one method to help develop or inform the other method, where development is broadly construed to include sampling and implementation, as well as measurement decisions
Initiation	seeks the discovery of paradox and contradiction, new perspectives of frameworks, the recasting of questions or results from method with questions or results from the other method
Expansion	seeks to extend the breadth and range of inquiry by using different methods for different inquiry components

3.2.3 Basic Mixed Methods Designs

There are five major mixed methods research designs, each trying to address a different type of problem; convergent parallel design, explanatory sequential design, exploratory sequential design, embedded design, and multiphase design. (Creswell et al., 2003)

Convergent Parallel Design

This design implements concurrent qualitative and quantitative strands in the same phase of a study. The strands have the same priority, and they are independent of each other, mixing the results at the interpretation phase of the method. Figure 3.1 illustrates a convergent parallel design.

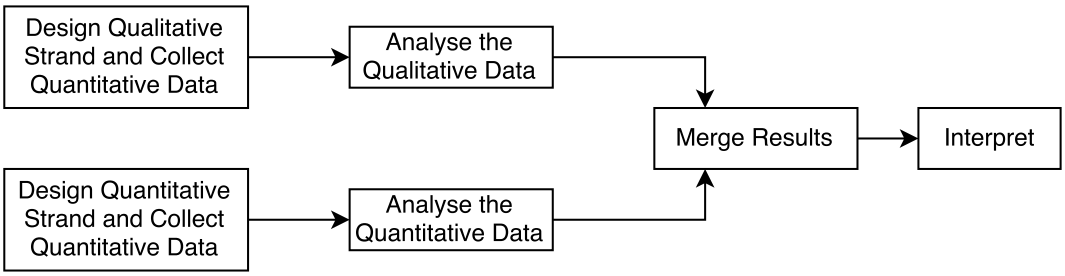


Fig. 3.1 Convergent parallel design (Creswell et al., 2003)

Explanatory Sequential Design

This design has two distinctive strands, a quantitative strand followed by a qualitative strand. The two strands in this design are not independent of each other. The results from the first quantitative strand will shape the qualitative strand, aiming at explaining the results from the quantitative strand. Figure 3.2 depicts the explanatory sequential design.

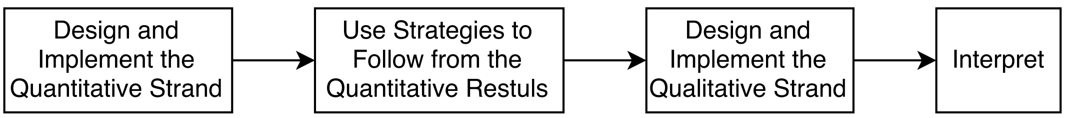


Fig. 3.2 Explanatory sequential design (Creswell et al., 2003)

Exploratory Sequential Design

This design has two distinctive strands, a qualitative strand followed by a quantitative strand. The priority in this design is given to the qualitative strand, which then feeds the quantitative strand. The main aim of this design is to explore in the qualitative strand and then confirm and generalise the findings in the quantitative strand. Figure 3.3 presents the exploratory sequential design.

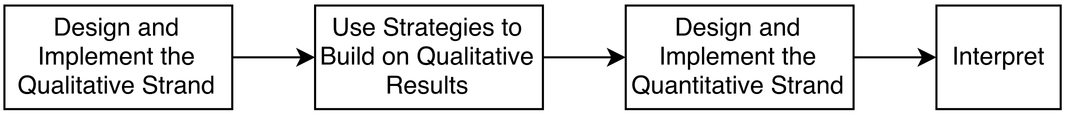


Fig. 3.3 Exploratory sequential design (Creswell et al., 2003)

Embedded Design

This design occurs when research has conducted a qualitative or quantitative study within a traditional quantitative or qualitative study. The supplementary strands are added to enhance the overall design and provide additional support for the findings of the investigation.

Multiphase Design

A multiphase mixed methods design occurs when the research requires greater time, and the previous designs would not suffice for answering all the research problem, purpose, and questions. Hence, a multiphase mixed methods design divides the research into smaller studies which are aligned sequentially, and each new one is built using the findings of previous studies. The main purpose of the multiphase design is to address a set of incremental research questions which fall into one common research objective. Figure 3.4 depicts the multiphase design.

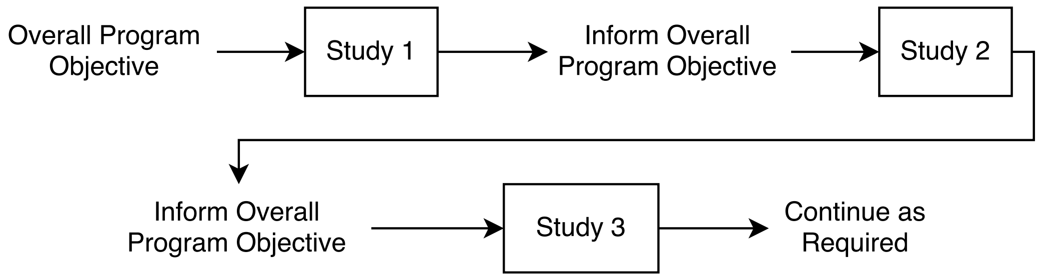


Fig. 3.4 Multiphase design (Creswell et al., 2003)

3.3 Design Science Research

Design science research provides a collection of guidelines for performing research in information systems. Design science research follows a pragmatic philosophy to understand and improve human performance (Van Aken, 2005). Design science research tries to gain knowledge and understand the problem through shaping ideas, designing, creating, and testing artefacts (Von Alan et al., 2004). The design science research, depicted in Figure 3.5, breaks the study into three cycles – relevance cycle, rigour cycle, and design cycle. Each of these cycles is described in the following.

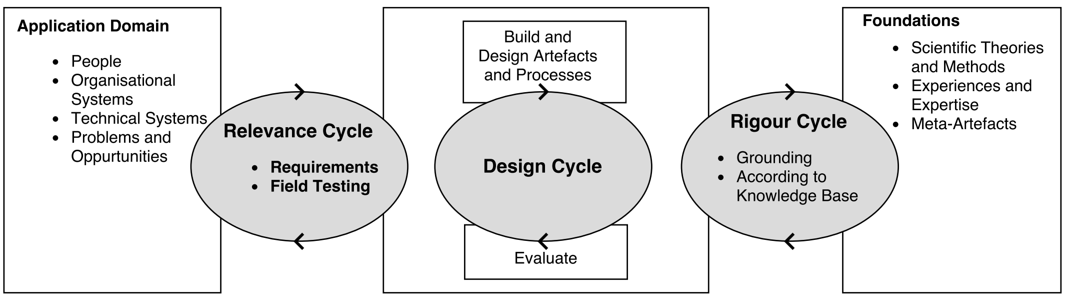


Fig. 3.5 Design research cycles (Von Alan et al., 2004)

3.3.1 Relevance Cycle

Design research cycle has the intention of enhancing an environment by designing and creating new and innovative artefacts, and processes for building these artefacts Hevner and Chatterjee (2010). The environment is shaped by the organisational system, technical system, and humans within that system who interact with each other to fulfil the goals of the system as a whole. A proper design science research needs to investigate the application domain thoroughly to identify issues, problems, and potential improvements in an application domain. The relevance cycle of the design science research is responsible for achieving this. The relevance cycle defines the requirements for the research and the acceptance criteria which helps in the evaluation phase.

3.3.2 Rigour Cycle

According to Hevner and Chatterjee (2010), design science uses a vast knowledge base of scientific theories and engineering methods which enable a rigorous design science research. This knowledge base includes two categories of knowledge; the expertise and experiences, which define the state of the art, and the existing artefacts, meta-artefacts, and processes available in the application domain. The rigour tries to ensure the ideas being created through the research is not already a standard practice and artefact available in the application domain.

3.3.3 Design Cycle

The design cycle deals with the outcome of the design science, which involves its construction, evaluation, and evolution through feedback. The design cycle seeks a balance between the construction and the evaluation, Hevner and Chatterjee (2010) argue that a substantial effort for the building of the artefact would not suffice if the evaluation is not satisfactory. Hence, a balance between the two is necessary, demanding a rigorous and scientific evaluation before any field test.

3.4 Adopted Research Methodology

It is in the interest of this research to employ both empirical and non-empirical methods, with the empirical investigations necessitating to include both qualitative and quantitative approaches. Hence, a pragmatic study would seem a fit choice for this research. Adopting the design science research to shape the structure and guide through the steps of this research has enabled a rigorous and systematic approach towards solving the research question. The design science research ensures the novelty of the approach in the relevance cycle, its working status through the design cycle, and its fitness for the application domain through the rigour cycle. The steps followed in each cycle are described in the following.

3.4.1 Relevance Cycle

This research has conducted an extensive literature review and empirical studies to explore the current state of the art and state of the practice in the field of digital motivation. The literature review involved investigating relevant subjects to digital motivation. Firstly, motivation in its classical definition and application was explored from a psychological perspective, which enriched this research with a thorough understanding of definitions, constituents, methods, shortcomings, and strongholds of current techniques on motivation. Next, this study explored relevant fields of study to digital motivation. Various subjects fall into the scope of digital motivation, in which all share a common goal of increasing the motivation and engagement of their users through digital means. Mainstream fields in which can be considered as digital motivation are gamification, persuasive technology, games with a purpose, serious games, and entertainment computing.

To enhance the knowledge base, clarifying the controversial aspects of digital motivation, and identifying challenges which may not be addressed in the literature, sequential mixed methods empirical studies were conducted. The literature study has

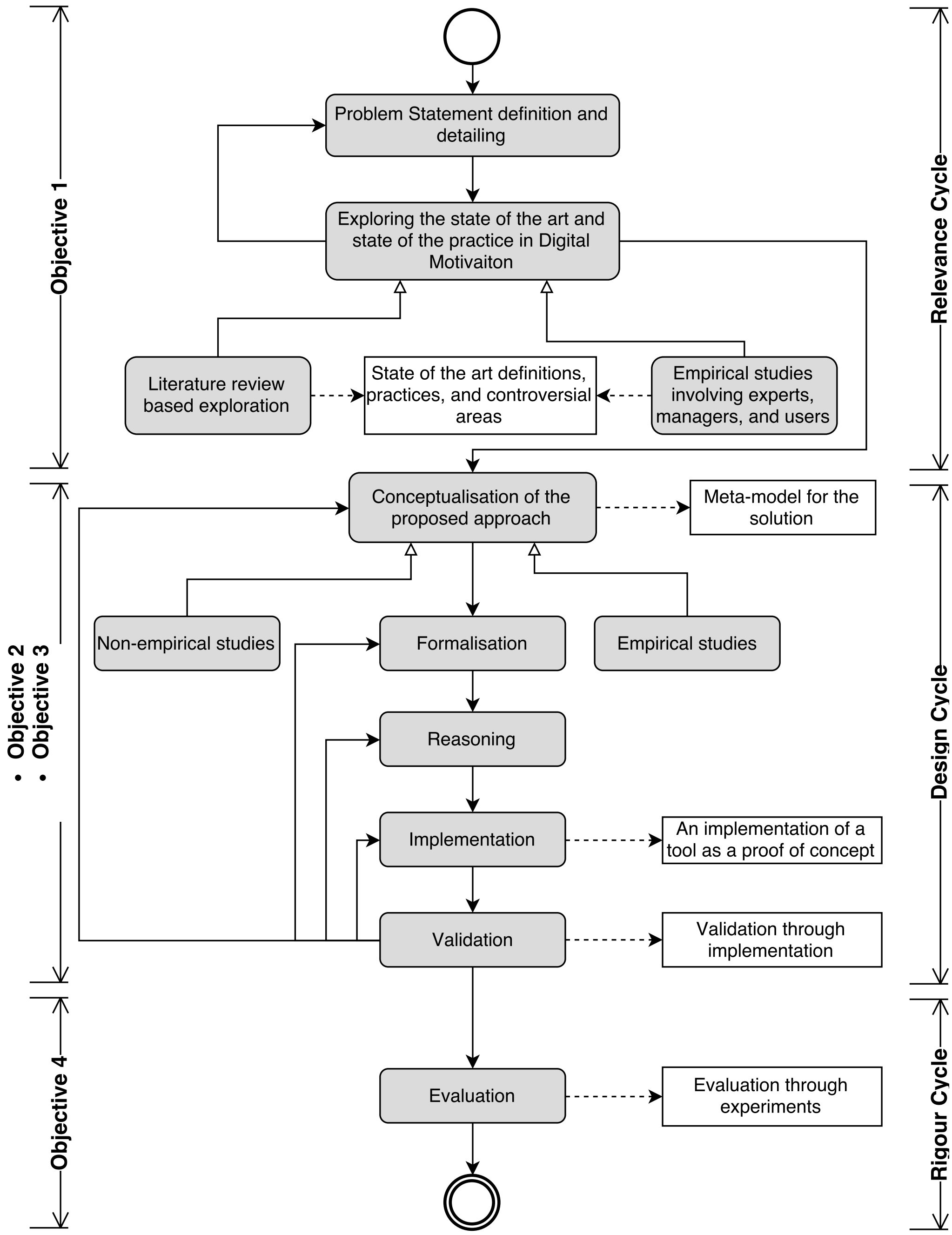


Fig. 3.6 Adopted research methodology

identified ambiguous and controversial aspects of digital motivation which needed further clarification and discussions with the experts in the field. Specialists in the field of digital motivation have been identified and invited for interview sessions for further debates on the identified aspects. A content analysis was performed on the findings of this qualitative study to derive the themes and aspects which required clarification and further studies. The content analysis has led to the creation of a questionnaire with open-ended questions, enabling the collection of qualitative data from the participants for further clarification on their answers where necessary.

Experts in the field of digital motivation were identified and invited to take part in a survey, answering the provided open-ended questionnaire. The responses of the participants were statistically analysed, and content analysis was performed on the provided comments. The findings of this stage required confirmation from the people who had experience using digital motivation within their workplaces.

For confirmation purposes, a qualitative study was conducted. The findings of this phase of the study were discussed with managers and employees with the experience of digital motivation within their workplaces. Insights from the managers and the employees have enhanced the knowledge base of this research in the field of digital motivation which enabled the design of an approach towards addressing the identified issues and challenges.

3.4.2 Design Cycle

The design cycle of this study deals with the creation of the artefact this research produces. The processes and guidelines of the design science research provide the steps necessary to conceptualise digital motivation, constituents that shape digital motivation, and those constituents which may have an impact on digital motivation. The resulting artefact will be a meta-model which describes these constituents and the relations between them. This meta-model needs to go through various iterations of empirical and non-empirical studies to derive the constituents, characteristics, and their relations. Empirical investigations on the findings of the relevance cycle and non-empirical research will enable the identification of frameworks which can enrich the meta-model, techniques to mathematically and formally specify and describe the meta-model, and create graphical notations to enable graphical representation of the models created using the meta-model. Moreover, empirical studies are required to enrich and confirm the results of the non-empirical studies.

The design cycle of this research tries to conceptualise digital motivation, describe it through formal mathematical specification, and provide reasoning to test the ability of the artefact in detecting various properties and contextual issues which are difficult to detect without the use of the conceptualisation and the meta-model. Moreover, the artefact that is a modelling language will be implemented and validated through various cases and scenarios. Any shortcomings identified in the validation step will need to be fixed, and the artefact must be amended accordingly. This identification and amendment must happen in various iterations for error detection and error correction, which will enhance the final artefact.

3.4.3 Rigour Cycle

The rigour cycle deals with testing whether the final artefact of the research is fit for the application domain through scientific evaluation methods. It must be tested if the artefact is meeting its goals, contributes to the knowledge, and is not already standard practice in the domain of digital motivation. This can be confirmed by performing the evaluation through experts in the area of software systems modelling and comparing the artefact of this research with available processes in the literature and the application domain. The result of the evaluation phase will identify the fitness of the artefact for the application domain, its strengths and the areas which require further investigation and enhancement.

3.5 Ethics in Research

Research that involves humans as its participants raises important and complex ethical concerns. Ethics in research tries to ensure the health and safety of the human participants, and to ensure the researches contribution to be in the interest of individuals, groups, or societies. These are achieved through assessment and management of the risks that the research may pose to its participants, protection of confidentiality throughout the data collection and analysis, and the process of informed consent from the human participants. In this thesis, all phases of the research will go through an online ethics check-list which will be assessed by experts in the field of ethics in research for their approval. In case the research is found to pose potential risks for the human participants, a hearing session in a research ethics committee will be conducted and the decision will be made. All participants in all phases of the studies in this thesis will be provided with an information sheet which will describe the research, its aims, and its benefits for the participants, as well as contact details in case further information is required. In addition, the participants will be given a consent form to sign prior to the commencement of each study. The consent form informs the participants that their information will be anonymised and used for research purposes only, as well as informing them that they can withdraw from the research at any stage to the point of data anonymisation.

3.6 Chapter Summary

This chapter summarised a number of research paradigms, approaches, and designs as options which this research could adopt. Next, the research philosophy, approaches, and design which this research has followed was discussed and sketched as a flow diagram. However, this chapter did not delve into the details of each step and process. These details are provided in the next chapters, respective to each of the steps in the research methodology, providing the information related to the actions taken towards implementing each of the procedures.

Chapter 4

Exploring Digital Motivation: The Consensus, the Best Practice and the Grey Areas

As the first step towards achieving the aim and objectives of this research, this chapter performs an empirical investigation to obtain a general understanding of DM, its foundations, established areas, grey areas, and the areas which require more clarification and further research. The results can help in better understanding of DM in more depth which aids in identifying constituents that shape a digital motivation system and assist in conceptualising the matter.

As discussed in Chapter 2, there are ambiguities in the field of DM concerning its definition, its design stakeholders, best practices, systematic approaches, measurability, and suitability of it for various environments. This chapter tries to explore these areas of ambiguity and provide with findings which can be utilised to provide clarity on ambiguous areas or pave the way for further investigations where necessary.

4.1 Chapter Methodology

This chapter adopted a sequential mixed-methods approach (Creswell et al., 2003). Initially, interviews with six experts were used to collect rich qualitative data and form the basis for a survey. The survey, completed by 40 identified experts, was first used to collect quantitative data and then analysed using descriptive statistics. The survey was on an invitation only basis, ensuring the relevance of the participants with the survey aims. The questions used in the interviews and the survey as available at Appendix A.

In this study, the term gamification was used interchangeably throughout the interviews and survey instead of DM for various reasons. Since the newness of the phrase could expose ambiguity and uncertainty in the responses from the experts, it has been decided to use the closest concept which can describe the facilitation of DM in a business context that is the primary focus of this study. As a result, gamification seemed the appropriate candidate since it has similar aims and objectives to DM and is well-known amongst the experts. This replacement helped in preventing an ambiguity in the questions asked of the participants by providing a known concept.

Nowadays, gamification could be seen as a sub-domain of DM as it mainly employs digital means to collect data, process and analyse the collected data, and perform. When used in a business context, it aims at increasing the operational goals of organisations, being the increasing performance of employees or preventing undesired behaviours, such as printing a large number of avoidable documents on paper. This is noteworthy that the digital usage and implementation of gamification is in the interest of this study and other classical and non-digital utilisations of gamification is out of the scope of DM and this research.

4.1.1 Exploratory Phase

Initially, this research used semi-structured interviews which allowed some flexibility in both the order of the questions and the prompts required to request elaboration, stimulate discussion, or creation of new questions. The newly identified items were used in the next interviews and also added to the survey.

Identification of Experts for Interviews

The aim of this phase was to gather important aspects of DM from a design perspective. For the purpose of identifying relevant experts to this study, this research considered high impact peer-reviewed publications available in the literature. Moreover, to gather a diversity of viewpoints, invitations were sent to experts from different affiliation types (academia and industry), fields of expertise (business, management, gaming, education), and countries. To prevent biased or skewed results, the selected interviewees had no work in common. Since opinions from different perspectives were in the interest of this research, this study invited experts who have implemented DM in practice, along with those who only worked with theoretical foundations of DM.

In the end, six experts agreed to participate in the interview phase of this research; four from academia (with one of them collaborating closely with industry), and two from industry. Three were involved in developing theoretical frameworks for DM, and three others had developed and applied DM in practice. Experts with more focus on academic and theoretical aspects had also implemented DM in practice as part of their studies for evaluation purposes. Hence, they also encountered implementational complications. The experts came from different countries and had varying levels of expertise with DM; UK four years, South Africa three years, USA four years, Portugal three years, Germany four years, and Canada ten years of expertise.

Interview Process

The average time per interview was 39 minutes (minimum 27, maximum 50). Questions were sent to the interviewees in advance which made the actual interviews more efficient and focused. After describing the aims of the study, participants were asked for their consent for voice recording the conversation. Once the ethical procedures were approved, interviewees were asked to talk about their expertise with DM, to confirm the correct selection of experts through their public profiles (e.g., for how long they worked on DM, where and in which domain). Before the interviews started, one pilot study was used to test and refine the interview questions.

Data Analysis

The recorded interviews were transcribed and the text was content-analysed to extract important issues. These identified problems were then grouped together to form a number of sub-themes. Two researchers worked on the analysis, and when a disagreement emerged, a third researcher was consulted to take a final decision. The questionnaire items, discussed in the next section, were formed based on the agreed themes.

4.1.2 Confirmatory Phase

This quantitative phase used a survey study designed to confirm and enhance the findings of the first qualitative phase, i.e. the interviews. The questionnaire included multiple-choice questions and an open text box at the end of each general question for participants to add any additional comments. The questionnaire was piloted on two participants and refined to remove any ambiguity.

Table 4.1 Characteristics of the participants

Years of Experience	
Min	1
Max	10
Mean	3.12
Median	3
Mode	3

Level of Practical Experience		
Expert	7	18%
High	18	45%
Medium	14	35%
Low	1	3%
None	0	0%

Table 4.2 Distribution of participants

Participants per Country				**Participants per Area of Expertise**			
UK	11	Switzerland	2	Education	11	Exertion Interfaces	1
USA	6	China	1	Psychology	7	General	1
Netherlands	6	Italy	1	Enterprise	4	HCI	1
France	3	Japan	1	Tourism	4	Marketing	1
Germany	3	Taiwan	1	Linguistics	3	Modelling and Theory	1
Portugal	2	Norway	1	Game Design	2	Sociology	1
Spain	2			Software Ergonomics	2	Software Engineering	1

Identification of Participants

Authors of peer-reviewed and published publications were invited via email to take part in the survey. The study was designed to find consensus, grey areas, and controversial aspects of DM amongst the experts. A private link to the questionnaire was then sent to each expert who accepted the invitation. Table 4.1 summarises the characteristics of the participants. Given the novelty of the concept, the contributors who specified their level of practical experience with DM as medium-level are still experts in areas which are core to the design of DM, e.g., incentive-centred design, cyber-psychology, and human-computer interaction (HCI). One expert stated low practical expertise since their expertise was on the psychological aspect of DM. However, their participation was valuable as it helped in balancing the view and opinions elicited from industrial and academic perspectives.

As in the qualitative phase, experts from different affiliations were invited to ensure diversity of perspectives and opinions. Table 4.2 provides the distribution of participants based on their field of study and country.

Survey Procedure

Forty-eight experts started the survey, and 40 of them completed it. In addition to the descriptive statistics, the comments given by the experts at the end of each question were collected and analysed to identify further insights and explanation for the statistics.

4.2 Results

The data from the two phases have been integrated, and therefore the results are presented here under the following eight areas:

- Defining various types of DM;
- Relevant fields and disciplines;
- Stakeholders;
- When to use DM;
- Concerns and considerations in development;
- Systematic approaches;
- Ethics and;
- Best practice recommendations.

The following presents the results of this study in percentages. Hereafter, this chapter uses **SD** for strongly disagree, **D** for Disagree, **N** for neutral, **A** for agree, and **SA** for strongly agree throughout the paper.

4.2.1 Definition and Differences in the Perception of Digital Motivation

The interviewees were asked to give their definition of gamification, in particular, its core elements and peculiarities in comparison to other closely-related concepts such as serious games and GWAPs. These questions were asked since different definitions and understandings in the literature about gamification, serious games, and GWAPs were observed. There is no agreed definition currently available, or a taxonomy which accommodates the commonality and variability of those definitions, although attempts to put a standardised definition have been made (Deterding et al., 2011a; Groh, 2012; Huotari and Hamari, 2012).

The interviews resulted in extracting ten distinct themes. Each theme then developed into a statement, see Table 4.3. The results suggest there is a considerable amount of diverse opinion on the nuances of some statements. Experts do not share a common view on gamification in relation with serious games and GWAPs. One controversial statement was S1.1 where there was a belief that gamification will convert a task into a game. Despite several declarations in the literature that gamification only uses game design elements, and is not a game per se, a considerable proportion of opinions (29%) did not agree with this statement. Moreover, S1.9 shows that despite gamification being reasonably defined in the literature, still it cannot be differentiated from serious games and GWAPs. Only eight per cent disagreement was observed on S1.10, showing that experts differentiate between digital games and gamification, while the same question was debatable when applied to serious games and GWAPs in S1.8. One view believed that there is a "grey area between gamification and serious games" and deciding whether it is gamification or serious games, depends on the "perspective of people who are making the decision". On the other hand, some others believed that "gamification is about adding game elements to a non-gaming context" where serious games are "applied games used

Table 4.3 Statements for definitions and perspectives

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	**D**	**N**	**A**	**SA**		
S1.1	Gamification will convert a task to a game	28	31	13	21	8	0.12	2.42
S1.2	Gamification is meant to achieve a certain users' behaviour when doing certain tasks, e.g., more engagement and motivation	0	5	5	56	33	0.25	4.15
S1.3	Gamification is not standalone and it should be always designed to work in conjunction with certain task(s)	0	0	8	39	53	0.26	4.51
S1.4	Gamification should be applied on tasks which are being used already (not before or in parallel)	10	21	21	33	15	0.09	3.12
S1.5	Gamification has its own added value, i.e., it is a part of user value creation at work, not only those related to behaviour change when performing specific tasks	0	15	26	49	10	0.17	3.55
S1.6	The main goal of gamification is to increase motivation	3	18	15	49	15	0.17	3.56
S1.7	Gamification must lead to enjoyment	5	18	13	49	15	0.18	3.53
S1.8	Serious games and games with purpose are games by nature	5	21	21	38	15	0.13	3.50
S1.9	Serious games and games with purpose can be considered a kind of gamification (when you make the task as a game, then you gamify the task)	10	36	13	26	15	0.09	2.82
S1.10	Gamification is not a game.	0	8	10	49	33	0.19	4.08

to deliver more than just entertainment". Another controversial statement was S1.4 where an uncertainty amongst the opinions can be observed about the question that should gamification be added to an already designed business process, or it can be developed and added to an environment before or while designing the business processes.

4.2.2 Relevant Fields of Study

The next question in the interview was designed to collect opinions about the fields of study that should be involved in the development process of DM and gamification in particular. From the interviews, seven various areas of study were retrieved, and then confirmed and enriched the list through the survey. The statements and the results are provided in Table 4.4.

User experience, HCI, psychology, and game design seem to be highly recommended fields to be involved in the development process of DM. The percentages suggest that management and human resources, behavioural economics, and software engineering could be included in the process as well, perhaps with less importance in comparison to the others. It was signified that gamification might not always be software-based, e.g., bulletin boards with ticks for points in small teams, or it might use technology at a very limited scale, such as screens in public places with some indicators of collective performance. These settings make software engineering and HCI less relevant. Finally, by analysing the added comments, social science was recommended by a number of respondents as a related field, e.g., to study group dynamics.

4.2.3 Stakeholders

After enquiring the fields of study that should be involved in the design process of DM and in particular, gamification, this research investigated for the stakeholders that should be included in the design process. This information would aid DM developers to know whom to consult. As a result, a set of eight primary stakeholders were deduced which are presented in Table 4.5 with their respective results.

It was highly agreed by participants that end-users, IT developers, researchers, and domain experts should be considered as stakeholders or consultants. However, the degree of consensus suggests that there is less need for strategy makers and management, legal departments, security and privacy engineers, and behavioural economic experts. In this research, these areas are considered as part of the ecosystem to which DM belongs. They would inform its decisions and maximise the chance of its correct implementation and integration. An interesting insight came

Table 4.4 Statements for relevant fields of study

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	D	N	A	SA		
S2.1	User Experience: e.g., to understand users' behaviour towards the business and tasks and also game mechanics	0	0	0	36	64	0.28	4.58
S2.2	HCI: e.g., gamification requires careful, sometimes novel, design of Human Computer Interaction	3	3	10	36	49	0.22	4.26
S2.3	Psychology: e.g., for motivation and engagement, and also deciding when a task or a gamification technique becomes boring	0	3	5	36	56	0.24	4.43
S2.4	Game Design: game mechanics come originally from Gaming. Expertise in Game Design is thus needed, e.g., game rules and reward mechanisms	0	0	10	36	54	0.25	4.49
S2.5	Management and Human Resources: e.g., gamification could have an impact on the performance and the social relationship between employees (users)	3	8	36	38	15	0.16	3.58
S2.6	Behavioural Economics: e.g., whether competition and leader- board would increase the performance and quality of doing a certain task for certain groups of users	3	10	21	46	21	0.18	3.71
S2.7	Software Engineering: e.g., to systematically construct gamification from requirements, to design, to implementation and testing	0	25	26	38	21	0.16	3.61

Table 4.5 Statements as to who are development stakeholders

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	D	N	A	SA		
S3.1	Strategy makers and management: e.g., gamification may lead to changes of behaviour and thus affect the organisation social structure (when using leader-boards, reputation, etc.)	0	10	18	46	26	0.16	3.84
S3.2	Legal department: e.g., collected points indicate whether the employee is doing the work. Can that be used by managers when deciding to promote an employee?	5	28	28	23	15	0.13	3.07
S3.3	Security and privacy engineers: e.g., listing the top 10 in leader- boards, means others are not in the top 10. Points reflect a person's performance.	3	32	18	26	21	0.14	3.10
S3.4	End-users: e.g., for testing and validation and feasibility study	0	0	5	44	51	0.24	4.36
S3.5	Behavioural economic experts: e.g., for gamification design which is informed by the effect of social and psychological aspects on business objectives.	5	5	16	45	29	0.16	3.91
S3.6	IT developers: for managing the development and maintenance of information technology e.g., real-time communication, video server, communication channels	0	5	23	38	33	0.19	4.04
S3.7	Researchers: e.g., research is needed in most gamification projects as we still do not have ready-to-use solutions or templates for such an emerging field	0	5	18	36	41	0.17	4.06
S3.8	Domain experts: e.g., experts in the business being gamified will inform the design of correct gamification	0	3	8	44	46	0.23	4.27

from one expert who further added that it is mandatory that the legal department should be involved, since "gamification may be used as exploitation-ware" and gamification is not just about "[the technical side] of designing BPL [(badges, points, and leader-boards)]". It was also suggested that a "professional" game designer could be considered in addition as a stakeholder or consultant, given that gamification borrows most of its techniques from video games industry.

4.2.4 When to Use Digital Motivation

The situation when the use of DM, in particular, gamification, was appropriate in an environment was another aspect which was investigated in this chapter. The knowledge about this helps organisations to decide whether they need to apply DM and whether it is feasible and cost-effective to implement it. Five insights were retrieved from the experts, which are presented with their respective results in Table 4.6. A high rate of agreement on all the statements in this section was observed, and none of the respondents made any additional recommendation.

4.2.5 Concerns and Considerations in the Digital Motivation Development Process

The next statements cover the concerns developers and business owners should take into account while developing DM so that they can avoid the negative impacts it may have in both the short and long terms. Knowing these concerns and issues beforehand can prevent organisations from applying DM in a way which is not cost-efficient, and sometimes is detrimental to their ultimate goals. The cost here does not only refer to financial development expenses, but to those related to the side-effects of applying it.

While some of the statements (S5.3 to S5.9) had a high rate of agreement, the others had a considerable amount of neutral responses or disagreeing responses. This could mean that there is still to some extent a lack of enough knowledge to confirm or reject such statements and further research is still needed in this area. For example, one of the experts strongly disagreed with the statement that removing the rewards will eliminate the intrinsic motivation with it. This was advocated based on an empirical study that the expert conducted. Some others stated that “knowing your players is a key” and believed that each type of user or environment needs their own design of DM. This should not discourage developing engineering approaches which

Table 4.6 Statements about when to use digital motivation

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	D	N	A	SA		
S4.1	Theoretically, gamification can address any task, any user and enterprise. This does not mean it is easy to implement correctly, but the idea itself has no restrictions	8	15	3	46	28	0.20	3.86
S4.2	Gamification should be used to achieve another goal, e.g., behaviour change. Gamification by itself is not an objective	0	15	8	46	31	0.18	3.82
S4.3	Gamification requires that the users' characteristics, enterprise, and context of the use are known very well, Gamification is not "one size fits all"	0	0	5	29	66	0.29	4.62
S4.4	Gamification is not a cheap solution from both technical and organisational perspectives. It should be used to support long-term goals and also when users/employee's loyalty is a key	0	10	13	46	31	0.19	3.97
S4.5	Gamification requires that we have clear business objectives and metrics to measure success and failure. This is preliminary to decide the suitability and feasibility of gamification.	0	8	18	38	36	0.17	3.99

take that variety of users into account and perhaps provide patterns and adaptation mechanisms for DM.

4.2.6 Systematic Approaches for Developing Digital Motivation

The next question in the interviewing phase was related to whether there exist practical, systematic approaches for the development of DM and in particular, gamification. The reason behind this question was that the clear majority of papers apply DM and especially gamification techniques as ready off-the-shelf solutions in a business context without explaining how decisions are made and which methodologies were followed. There is still lack of a clear picture whether DM and gamification should be built in conjunction with the business tasks and software supporting it, or apply it in a plug-in style with some configuration steps. By analysing the interviews, 12 insights were identified, which were subsequently confirmed by the questionnaire. The statements are presented in Table 4.8 with the respective results.

The results show that there exists a high percentage of agreement on the lack of practical, systematic approaches, e.g., "there is a lack of standard metrics and criteria for assessing the efficacy/feasibility of gamification". However, some thought that "there are some good guidelines" and "approaches, but they have many key failings". This would mean that even guidelines are still not validated. Interestingly, there is a debate whether systematic approaches are ever needed. Some thought that DM and "gamification development is not software engineering, [but] it is a game design". Others still believe that there should be engineering approaches that "combine conceptual theories and technical practicalities". Engineering DM could borrow certain techniques from user-cantered design, although it has its own unique challenges and there would still be a need "to standardise the instantiation of gamification" and DM to fit its own peculiarities.

Table 4.7 Statements for concerns and considerations in the digital Motivation development process

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	D	N	A	SA		
S5.1	Gamification should not be used when there is doubt about users' perception of gamification, e.g., certain users see gamification as trivialisation of their job	0	23	44	28	5	0.19	3.02
S5.2	It should not be used when it could change management style against the company norms. e.g., transparency about who has the highest performance would affect the way promotions are given by managers	15	31	23	26	5	0.12	2.69
S5.3	Users should not feel they are forced to use gamification as this will lead to negative impact on the enterprise and the well-being at work	0	0	21	38	41	0.19	4.14
S5.4	Gamification should not lead to undermining the task. Users should not forget that gamification is for making the task more interesting, but it is still their job to do the task	3	15	8	51	23	0.18	3.64
S5.5	It is hard to guarantee that every user will see gamification positively regardless of how testing and validation were conducted. It is highly personal	0	10	13	49	28	0.20	3.81
S5.6	Not all game mechanics are applicable for any kind of task, e.g., leader-boards might not be suitable for the task of a collaborative editing of a shared document	3	0	3	34	61	0.25	4.42
S5.7	The desire to win the reward may affect the quality of the work negatively, e.g., users may do tasks in a cursory manner to collect points and win	0	5	13	24	58	0.18	4.14
S5.8	A game mechanic has a lifetime. That is users might get disinterested with it and reject it after a while	0	5	18	58	18	0.23	3.79
S5.9	Gamification may lead to clustering users and changing the original structure of the organisation, e.g., good students could group together to win all the t-shirts given as a reward in gamified learning	3	16	18	50	13	0.17	3.51
S5.10	Not all game elements can be applied together, e.g., using competitive and collaborative elements together might not be a good idea	11	18	18	32	21	0.07	3.16
S5.11	Rewards are not good for intrinsically and already motivated users. If you remove the reward after a while, the intrinsic motivation goes with it	8	32	21	16	24	0.12	3.03
S5.12	Rewards are good for tasks which are not creative or intellectual. Rewards could distract users from applying their mind on the task.	8	24	26	29	13	0.12	3.2

Table 4.8 Statements relating to systematic approaches for developing gamification

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	**D**	**N**	**A**	**SA**		
S6.1	There is not any established systematic/rigorous approach available in the literature	5	5	23	41	26	0.16	3.84
S6.2	There are guidelines on certain facets of gamification. Guidelines are a looser form of systematic approaches	0	13	15	62	10	0.25	3.82
S6.3	There is not necessarily a systematic approach to build gamification, it is a highly creative activity and systematic approaches could hinder success	3	23	21	44	10	0.14	3.34
S6.4	The engineering of gamification could be seen as a variation of user cantered design	0	13	28	44	15	0.15	3.61
S6.5	User cantered design is supportive but not enough for the engineering of gamification	0	18	15	59	8	0.25	3.71
S6.6	The engineering of gamification is not simply an assembly of other approaches, e.g., motivation theory, gaming, business analysis, etc. It has its own challenges and requires novel engineering approaches	0	8	15	51	26	0.21	3.9
S6.7	Business objectives should be considered from the start, i.e., gamification alignment with business objectives is core	0	5	8	51	36	0.23	4.02
S6.8	There is a lack of standard metrics and criteria for analyzing the feasibility of gamification	3	4	23	47	23	0.18	3.83
S6.10	There is no guarantee of the success of gamification	0	3	11	47	39	0.22	4.2
S6.11	There are tools to aid the design of gamification, e.g., tools offering templates and patterns and check-lists, but not rigorous approaches	5	5	28	51	10	0.23	3.58
S6.12	It is a mistake to think of gamification as a piece of software to engineer. It is a technique to customize and apply in the first place	0	0	13	42	45	0.21	4.52

4.2.7 Digital Motivation and Ethics

The use of DM and especially gamification is a new trend in businesses, motivated mainly by the hope to increase productivity, though this research argues that it may not always be cost-free. DM and gamification could raise ethical issues and affect the mental and social well-being of employees and might be detrimental to the team. For example, leader-boards could put those people who never appear in them into an amotivation state; a complete absence of motivation and giving points upon completing a task could be overly stressful for some and lead employees to complete tasks hastily and without care. In the interview phase, there was a discussion on ethical issues and professional practice that may need to be considered when applying DM in a business environment. These statements and their respective results are presented in Table 4.9.

A high rate of agreement on the statements in this section was observed. Participants unanimously agreed that introducing DM to a business environment can have potential ethical issues. If contextual elements such as culture, norms, and personality of users are not considered in the design process, DM may lead to problems such as adding stress and pressure on people, drive them to sacrifice privacy, or create clusters of users and isolate some others.

4.2.8 Notable Recommendations

As the last question, the interviewees were asked about best-practice recommendations for developing and applying DM. These questions were aimed at producing a body of knowledge coming from previous experiences of domain experts. Eleven recommendations were gathered which are presented with their respective results in Table 4.10.

A high rate of agreement on the statements in this section was observed. There was a consensus on considering the business environment and the end-users in the

Table 4.9 Questions for gamification and ethics

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	**D**	**N**	**A**	**SA**		
S7.1	Gamification can lead to tension in the individuals/groups relations, e.g., when applying a leader-board	3	5	13	51	28	0.17	3.9
S7.2	Gamification can lead to exposure of information users are not necessarily willing to expose, e.g., saying who are the top performers	0	10	15	44	31	0.18	3.83
S7.3	Gamification can create tension in the person, i.e., it can be looked as a monitoring system on how well a person is performing	0	13	5	51	31	0.20	3.9
S7.4	It could lead to rating people and creating classes, i.e., additional pressure on some people and change in the equity principles	0	13	15	49	23	0.17	3.67
S7.5	Gamification ethics are highly dependent on the norms and culture of the organisation	0	5	10	51	33	0.22	4.21
S7.6	Gamification captures a lot of personal data, e.g., about performance. Privacy policies and data protection need to be augmented by ethical awareness	3	5	26	38	28	0.16	3.7
S7.7	The desire for winning could drive some users to overlook how data is gathered and to whom it is exposed. This makes some users, at times, vulnerable	0	18	15	44	23	0.17	3.67
S7.8	Ethics in gamification could be seen analogous to those in marketing, i.e., gamification could make some tasks attractive to users who would not ethically like to perform without gamification	0	8	33	46	13	0.20	3.56
S7.9	Gamification, in certain cases, could mean trying to get from people more than what their job requires, i.e., using gamification as an “exploitation-ware”	0	23	13	38	26	0.15	3.6
S7.10	Ethics should be seen case by case and even at the individual user level, e.g., the same game mechanic for the same task may be seen differently from ethical perspective according to the user	0	5	26	50	18	0.24	3.84
S7.11	Freedom of Information. Users’ ability to see what is stored about them is an ethical issue	0	8	10	44	38	0.19	4.16

design process of DM. Users can differ from various aspects, namely their personality, age, gender, and cultural and social background, which seem to have a high impact on how DM should be designed. In addition, the environment that DM is being applied to has various aspects, such as management style, culture, work style, and nature of the job that have to be considered in the design process of DM. Neglecting these aspects may lead to a DM design that does not satisfy some users' requirements, or is against norms, nature, or goals of the business which in both cases, can be detrimental to the ultimate purpose of adding DM to a business environment.

4.3 Discussion

In this section, findings are discussed in two sub-sections. First are the aspects of DM that gained a collective agreement and provide a body of knowledge that can aid DM designers in increasing the quality of a DM design. Second is a discussion on the implications of the findings, in particular noting those areas where there were disagreements, or ongoing debate, which need further investigations.

4.3.1 A Body of Knowledge on Digital Motivation

This section discusses the agreed aspects of DM from the perspective of practitioners and researchers, see Figure 4.1.

Definition

This sub-section elaborates on the findings in section 4.2.1 and discusses what defines gamification and how it is differentiated from serious games and GWAPs.

There seems to be a tendency towards accepting the definition provided in (Deterding et al., 2011a,b). Despite what the name suggests, gamification is not a game. It merely uses some elements that are used to shape a game to achieve

Table 4.10 Statements of best-practice recommendations for gamification

Statements		Results in Percentages					Stn. Dev.	Mean
		SD	D	N	A	SA		
S8.1	Gamification should focus on end-users. Adopting gamification without a rich knowledge of users could turn to be harmful on users' experience and consequently the business	0	8	3	41	49	0.23	4.3
S8.2	Age is a distinguished user attribute, e.g., elders might not like virtual rewards	5	28	18	36	13	0.13	3.12
S8.3	Gender is a distinguished user attribute, e.g., males may like competition, females may like cooperation	10	26	13	46	5	0.16	2.97
S8.4	Social background is a distinguished characteristic of users to consider, e.g., some cultures are reputation-oriented while some others are not	3	10	23	54	10	0.19	3.54
S8.5	Gamification should be informative, people like feedback on how they are doing	0	5	3	49	44	0.26	4.41
S8.6	Users should not feel they have to rely on gamification, i.e., they should be still able to do the task perfectly without gamification	0	3	21	44	33	0.19	4.04
S8.7	We cannot decide the applicability and efficiency of a game mechanic per se; amongst other aspects, an analysis of the task and users should be made	0	5	13	54	28	0.21	4.04
S8.8	Gamification should be configurable by managers, e.g., the tasks, the user groups, and the periods to activate and deactivate	5	3	46	31	15	0.19	3.55
S8.9	Management and work style, hierarchical vs. non-hierarchical, need to be considered, e.g., leader-boards may seem odd in highly collaborative teams	3	5	21	38	33	0.15	3.84
S8.10	The word gamification might lead to a negative reaction by some managers, e.g., trivializing the work. Words like behaviour change, employee engagement could be used interchangeably	5	28	28	33	5	0.15	2.96
S8.11	It is desirable that gamification is designed as an adaptive mechanism, e.g., depending on the type of users, the culture of the group, the business status, etc.	0	0	8	58	34	0.25	4.21

non-game objectives. This is where gamification is different from serious games and GWAPs. Serious games and GWAPs are in essence, fully-fledged games, however, they pursue non-game goals, e.g., education.

There are a number of properties that a DM design should possess. As such, aiming at increasing motivation and engagement in its users is one of these properties. DM and gamification per se do not improve performance or quality of work. They should be designed in a way that increases motivation and engagement in the end-users, which may lead to an increase in their performance and quality of the work subsequently. Besides, DM should be meaningful for its users, create added value for them, and create joy for the users in participating. Failure in creating this added value and providing the meaning in the design of DM for its target users will lead to DM's failure in motivating its users and increasing their engagement (Deterding, 2012). These aspects are substantial in how DM is defined and what properties it should contain.

Relevant Fields of Study

This sub-section elaborates on the findings in section 4.2.2 and discusses the list of relevant fields of study that their involvement in the design of DM can be beneficial to the final artefact. Based on the findings, in addition to the areas mentioned in (Herzig et al., 2015), the relevant fields of study that should be involved in the development of DM are as follows:

- User Experience (UX)
- Human Computer Interaction (HCI)
- Psychology
- Game Design
- Management

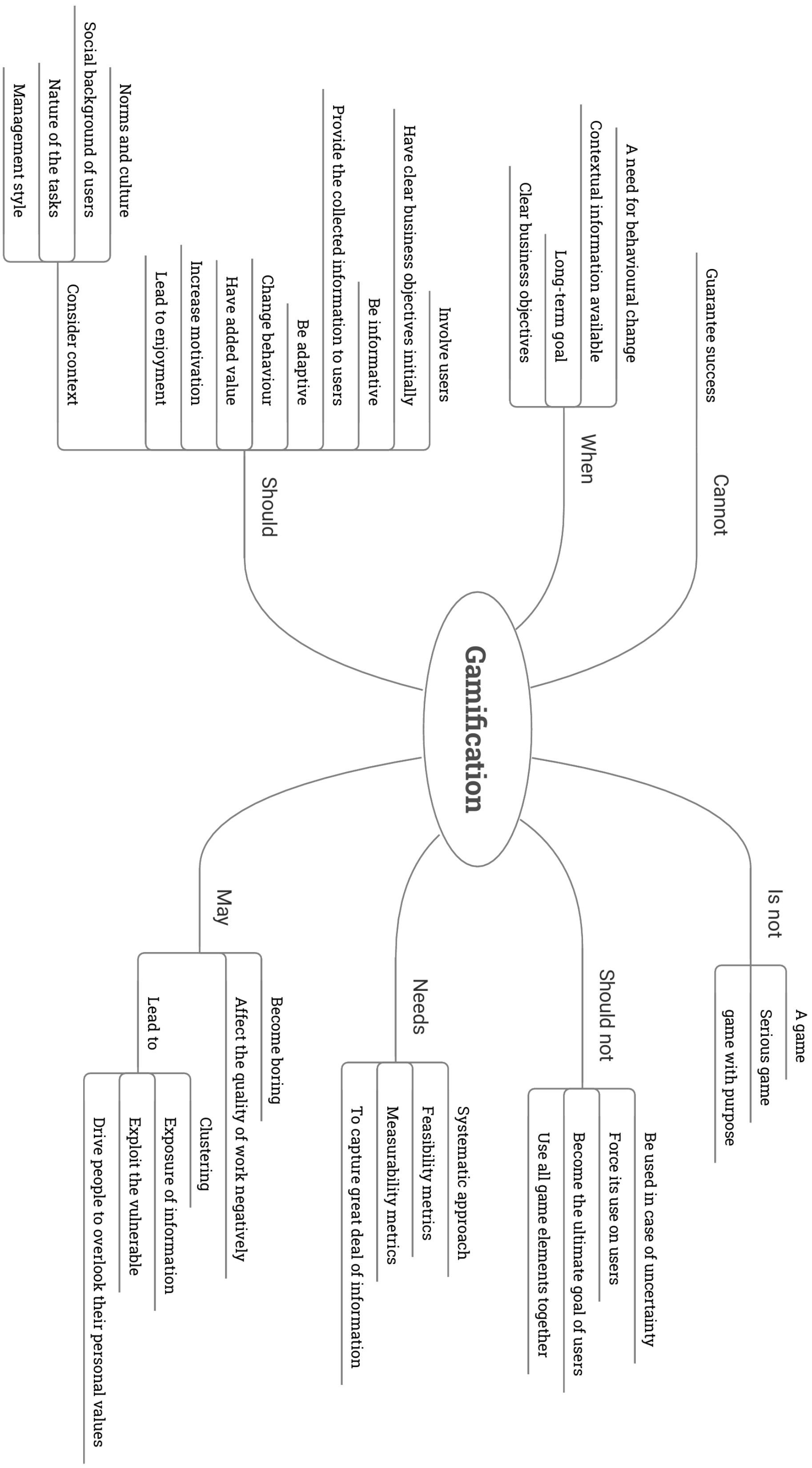


Fig. 4.1 A reference model for engineering digital motivation

- Behavioural Economics
- Software Engineering

DM targets the end-users and has direct interactions with them. Therefore, involving the knowledge from user experience (UX), human-computer interaction (HCI), psychology, and behavioural economics seem reasonable. These fields of study can provide the information about which strategies DM should follow to be successful in changing the behaviour of its users and observe a considerable increase in their motivation and engagement.

DM borrows its main elements from entertainment games. Therefore, game design is relevant to DM as it provides information about how game elements can be embedded in the business environment in an entertaining and enjoyable manner. Management is appropriate as well since they should advise on what goals DM should achieve and how to resolve possible conflicts that adding DM to the business environment may introduce.

Finally, software engineering is needed to model and engineer the design of DM. This involves features such as feasibility analysis, cost efficiency analysis, and measurability of the success for a design of DM before it is implemented in the business environment.

Stakeholders

This sub-section elaborates on the findings in section 4.2.3 and adds to the list of stakeholders proposed by (Herzig et al., 2015). This chapter lists the stakeholders that their involvement will benefit the design of DM as follows:

- Management
- End-users
- Behavioural Economics

- IT Developers
- Researchers
- Domain Experts

These stakeholders should provide rich information that can guide the design of DM in the correct path.

Management can inform the design of what the business objectives are and how they should be followed and achieved. End-users will enrich the design of DM with valuable information on what aspects of DM will motivate or demotivate them. Behavioural economics and domain experts will enhance the design with what behaviours are beneficial and how they can be achieved. IT developers will inform the design of the possibility and feasibility of requirements from a technical point of view. Finally, researchers will try to enhance DM and resolve problems that DM may introduce and have.

When to Use DM

Findings in section 4.2.4 suggest, when there is a need for behavioural change, DM can be used as one solution to achieve this goal. DM per se will not add to the performance of the employees or increase the quality of their work. It is useful when there is a lack of intrinsic motivation and engagement in the environment or bad habits that the organisation wants to eliminate by introducing rewards for the desired behaviours.

Another important aspect to consider is the availability of contextual information, that is, precise information about the environment, business objectives, and the users' characteristics that will be involved in the DM system. Designing DM without considering aforementioned contextual information can fail in meeting its ultimate goal and have detrimental effects.

Concerns and Considerations

According to the findings in section 4.2.5, the engineering process of DM would need to cater and provide countermeasures for a variety of concerns which may hinder its success and introduce risks.

One of the recommendations is that in the case of uncertainty of the outcome of DM; businesses should avoid it's introduction to their working environment. These uncertainties can be related to the impact DM may have on the business workplace or the perception of it amongst the users. In any of these uncertainties, introducing DM may not only fail in achieving its goal of motivating the end-users, but also may be detrimental, such as demotivating users which are already intrinsically motivated. Although the success of introducing a DM system to a business environment is not guaranteed, however, an attempt at reducing the uncertainties can lead to a decrease in the risk of failure.

In addition, it is noteworthy that DM should not be forced upon the users and they must be able to opt-out from using DM. Although, it is arguable that the peer pressure of using DM by others may prevent employees from opting out. Moreover, DM should not become the goal of the employees, and they should remember that their actual goal is to achieve their business objectives successfully and DM is introduced to the business environment as a facilitator to help them to do so.

Motives used in DM have their own nature and characteristics. For instance, some motives promote competition and some others, in contrast to competition, focus on increasing collaboration amongst their users. Therefore, a successful design of DM should take all the characteristics of these elements and choose those that comply with each other and do not cause conflict. In addition, the alignment of motive's characteristics with contextual situations is necessary. Contextual situations refer to the tasks, users, and business environment that DM is being introduced to.

For various reasons, users may lose their interest in a DM design. Therefore, a dynamic and adaptive design of DM is advised where users are constantly monitored to detect the need for a change in the design and trigger the need for a new solution, such as introducing a new motive.

It should be taken into account since DM can assess users according to their strengths and skills, shaping clusters of users is not an unexpected occurring. Although it was mentioned that this is not necessarily defective for the business objectives, there is a potential danger in having clusters of users, especially when it leads to isolation of some others who cannot maintain their performance with the top performers.

Finally, a DM design may drive employees to decrease the quality of their work, especially when DM is rewarding the speed of production and does not consider the quality of work while rewarding. It is a very significant concern for businesses planning to facilitate DM, where increasing the quality of work is a major goal.

Systematic Approach

DM is different from entertainment video games as it aims at the fulfilment of business goals through game elements and play is a secondary goal for corporations. Therefore, this research advocates a systematic approach towards the design and implementation of DM which can reduce risks and side-effects related to relying on the creativity of its designers and prevent possible losses in the business.

There are some templates and guidelines for how DM and in particular, gamification, should be designed and implemented, e.g., (Deterding, 2015; Herzig et al., 2015, 2013). However, findings in section 4.2.6 suggest that there still seems to be a lack of systematic approach, and feasibility and measurability metrics for designing DM. This is crucial to any system design as lack of them will cause uncertainty in its success or its introduction to the business may cost more than expected since the feasibility of adding it to the business was not analysed properly beforehand. In addition, the lack of a systematic approach in designing DM will make it hard to evaluate and assess its success before implementation.

Moreover, a DM design should involve its users and employ user-centred design techniques in order to identify user requirements in the design process and also have clear business objectives beforehand. This should help to achieve a design which is closer to what is expected from a successful DM system.

Ethics

The findings in section 4.2.7 suggest that DM deals substantially with psychological aspects of its users. Therefore, the engineering process of it should be performed with due consideration of any ethical aspects and impacts it may have. DM relies on collecting personal and work related information from the users and the business environment. However, how this collected information is used can impact whether DM will lead to ethical issues. Since DM often collects very detailed work information, it can be utilised as a very accurate and detailed monitoring mechanism by managers. This can create lots of tension among employees as managers can retrieve work habits of employees and put pressure on them to work continuously.

Also, competitive elements of DM can shape clusters of users with the same skill-sets or similar performance level. As mentioned earlier, this is not necessarily problematic on its own. However, there are potential risks such as users with the higher abilities and performance level cooperate with each other to stay on the top performers' list by helping each other and isolating others.

Moreover, the design of DM may exploit the vulnerable users, driving them to work more than their contract, without extra payment from the organisation, or be less concerned about their privacy just to achieve virtual goods. This, in the long run, can be defective for the social and mental well-being of the users involved.

Furthermore, a DM design should consider the norms and culture of the society or organisation it is being applied. Promoting competition in a community that competition is defamed in, is going to be ignored by the users or force them to perform in a way that they are reluctant to do.

Finally, DM should allow the users to have access to what has been collected about them by the use of DM. This should be available to the end-users in addition to the feedback that DM provides. Feedback is one of the primary drivers for employees as they will know how they are performing and allows them to decide in which part of their job they need to put more effort.

Recommendations

This section elaborates on the findings in section 4.2.8 and discusses the best practice recommendations of experts regarding the design of DM. There are several suggestions about how DM should be developed and implemented. However, this section discusses the ones that have a collective agreement.

One important aspect that is recommended to be considered while designing DM is the context it is being applied to and choose game elements and motives that are compatible with those contextual elements. These contextual elements could be the end-users, the business objectives, or culture of the organisation DM is being introduced.

Another important aspect is the managerial style in the business environment. There are various reasons that this becomes of concern since the way managers utilise DM and the data captured through it can change its impact and perception amongst users. If the managerial style tries to value collaboration and hard work through positive reinforcement, this is usually acceptable from the users' point of view, however, having a negative reinforcement and punishing users for being in the bottom of the list in performance monitoring, could be very detrimental.

In addition, it is recommended that DM should be configurable by either managers or end-users. This is a predominant feature that DM could have which can allow resolving many conflicts that DM may introduce or even change the design when necessary to avoid boredom and sustain motivation in its users. It is necessary for the design of DM to be adaptive. This can be achieved by the use of social adaptation (Ali et al., 2012) and social sensing Ali et al. (2011) to detect when the setting and design of DM are not working, or users have lost interest in it. Then, it can trigger the need for a change in the design to avoid its harmful side effects.

Finally, it is necessary for the design of DM to be supplementary to the environment, and it should not become the goal. End-users should be reminded all the time that DM is there as a facilitator to help them, and not to be the target of the business.

4.3.2 Debates on Digital Motivation

This subsection provides the debatable statements on DM reported in Section 4.2. Statements were considered debatable where the rate of agreement and disagreement were close and definite decision could not be made from the results.

Debates on the Definitions

The first debate is whether DM should be applied to a task after the users have already become familiar with it. The first view advocates that this should be the case as DM should not be seen as an intrinsic part of the task and could be removed eventually, but the work would remain, and the user should still be able to perform it. The second view expresses that this is not necessarily the case. This view argues that DM is a general paradigm that includes serious games and GWAPs.

In a more specific view on different types of DM, the first view believed that there is a possibility of designing gamification as a game, similar to serious games and GWAPs. The second view, on the other hand, preferred an exact and distinct definition of gamification and excluded the possibility of gamification to be designed as a game.

Stakeholders

There was a debate whether legal departments and security and privacy engineers should be considered as stakeholders. The first view advocated this opinion as DM means changing the work contract in particular cases, e.g., monitoring of performance. The other view preferred to detach that aspect from DM and advocated that it has to do with the strategy of the company and the way DM is used is not a concern for DM engineers.

Concerns

There are three debates here. The first debate relates to users' reaction and opinion about DM. That is whether there is a need to avoid violating users' experience, or DM is meant to lead to behaviour change, and uncertainty about its usage should be expected. The second debate is whether DM should be applied if it is going to modify the management style. Disagreeing views were analogous to the first debate. The third debate is whether the use of rewards, mainly tangible rewards, is not suitable for tasks which require intellectual contribution as they would be distracting. One view advocated it, with preference to use intangible rewards, e.g., social recognition, while the other view still sees rewards of all kinds the core of DM regardless of the task types.

Recommendations

The first debate related to whether age and gender are main factors in the success of particular motives. Different experts had different experiences regarding this aspect, which would call for further studies to investigate this. The other debate related to whether managers should be able to configure DM or a pre-planned DM should be applied. The debate mainly emerged because of the fear that this configuration could lead to subjective decisions, e.g., trying to exploit users. However, this seems to be an issue of management style rather than DM. The third debate relates the perception of DM itself. Some experts had experiences where managers viewed it as trivialising the work and therefore preferred to avoid using terms such as gamification or serious games, while some other experts believed that this is not applicable and these terms are now widely known and accepted.

4.4 Threats to Validity

The expert study performed in this chapter involved 46 experts (six in the interview phase and 40 in the survey phase). This was proceeded by a secondary research on the literature and distinguished projects on various types of DM such as gamification, serious games, and GWAPs. Moreover, another study was followed to gather users and managers' perspective so that the analysis reflections could be enriched. The survey questions were appended by text boxes so that experts could add further insights, which explained their choices in many cases. The questions were developed based on an initial qualitative phase and literature review, so their relevance to the study was ensured. The experts were selected based on their contribution to the field of DM, demonstrated via published works so that the credibility of their opinions is maximised. Experts from different institutes and countries were invited to avoid bias towards specific views of DM. In spite of these careful arrangements, this study still has some threats to validity, as outlined below:

1. Most experts had only academic expertise, which means that the opinions presented in this paper have an academic flavour. However, the majority of experts still applied DM in practice, e.g., via case studies to test their

contribution and research questions. This would mean that their opinions are not purely theoretical, but also substantiated by some practical experience.

2. This research recognises that some of the statements were about problems which still need to be investigated. Experts' opinions about these statements were to some extent speculative. However, their responses and comments enabled this study to identify those issues which are still a focus of debate or need further research, which are presented in subsection 4.3.2.

3. The study was, to some extent, biased towards DM in a business environment. Some experts observed such business emphasis in the questions. That observation itself would mean the domain in which DM is used could affect their answers. This study suggests that the results are feasible for a business context and the generalisability of these results to other domains is still to be explored.

4.5 Chapter Summary

This chapter conducted an empirical research to provide a holistic picture of DM and foundations for its engineering process. This included the meaning of the term, recommendations on the use, concerns to take into account, stakeholders and fields of study to involve, ethical issues that it may create, and best-practice recommendations. The goal was to provide a body of knowledge, which informs researchers and practitioners in their future work. This research also identified issues which were debatable and required further investigation.

Chapter 5

Digital Motivation in Business Information Systems: Conflicts and Ethical Concerns

In the light of the findings in Chapter 4, a critical aspect of a DM design is the ethical and professional issues that its ad-hoc and negligent design and implementation may introduce to business information systems (BIS). The importance and significance of ethics in the design of a DM system have led this chapter to delve more into details of various ethical issues that ad-hoc designs of DM may pose to the environment. This chapter provides a checklist for system analysts to allow the identification of potential ethical concerns and help in resolving them in advance prior to the design of DM.

5.1 Chapter Methodology

This chapter followed an empirical investigation to clarify the findings with regards to the ethical impacts which design and implementation of DM may have on a BIS.

Hence, it has been decided to focus on the results derived from the 11 statements with regards to DM and ethics in Table 4.9.

The investigation in this chapter involved interviews with professionals which had practical experience with DM in their workplace. To enrich the results with diverse opinions originating from various perspectives, professionals with managerial roles and employees were invited. As a result, 12 professionals agreed to participate in this study, five who typically had an administrative role and seven who were employees, all in different organisations. In addition to the diversity in roles, diversity in gender and age was considered, with nine males and three females, and their age ranged from 30 to 58 years old.

Participants were provided with research information sheet describing what to expect from the research, what is the aim of the study, why their participation is valuable, and how the study is planned to be conducted. Next, they have been provided with consent form stating that the study requires voice recording for transcribing purposes only and they can withdraw from the study at any point.

Participants were provided with one scenario prior to the interviews. Thirteen questions were designed to seek opinions on the ethical impact of DM on employees and BIS with regards to the given scenario. To ensure participants' fitness for the study, four additional general questions were asked from the interviewees seeking their role in their workplace, age, gender, and their experience with DM. A semi-structured interview method was used in this study and as a result, a total of 302 minutes of the interview were recorded. The interviews averaged 25 minutes, 14 minutes being the shortest, and 43 minutes being the longest. All the interviews were transcribed, and then their contents were analysed to valuable insights. Two researchers worked on the analysis, and when a disagreement occurred, a third researcher was consulted to mediate and reach a final decision. The questions used in this interview process and the scenarios used are available at Appendix B.

5.2 Results

By analysing the answers from the six expert interviewees in the exploration phase from Chapter 4, the below 11 statements on the relation between DM and ethics in a business context were deducted. In the confirmation and enhancement phase from Chapter 4, these statements were confirmed by 40 experts using a five-point Likert scale. For the purpose of readability, the results are repeated in this chapter as follows. The percentages are shown after each statement (**SA**: Strongly Agree, **A**: Agree, **N**: Neutral, **D**: Disagree, **SD**: Strongly Disagree).

1. Gamification can lead to tense relationship amongst colleagues, e.g. when applying a leader-board.
   (**SA:** 28%, **A:** 51%, **N:** 13%, **D:** 5%, **SD:** 3%)

2. Gamification can lead to exposure of information users are not necessarily willing to expose, e.g. listing the top 10 performers reveals if someone was never a top performer.
   (**SA:** 31%, **A:** 44%, **N:** 15%, **D:** 10%, **SD:** 0%)

3. Gamification can create tension on the person, e.g. it could be seen as a monitoring system on how well a person is performing.
   (**SA:** 31%, **A:** 51%, **N:** 5%, **D:** 13%, **SD:** 0%)

4. Gamification could lead to rating people and creating classes, i.e. more pressure and impact on the equity principles.
   (**SA:** 23%, **A:** 49%, **N:** 15%, **D:** 13%, **SD:** 0%)

5. Gamification ethics are highly dependent on the norms and culture of the organisation.
   (**SA:** 33%, **A:** 51%, **N:** 10%, **D:** 5%, **SD:** 0%)

6. Gamification captures a lot of personal data, e.g. about performance. Privacy policies and data protection need to be augmented by ethical awareness.
   (**SA:** 28%, **A:** 38%, **N:** 26%, **D:** 5%, **SD:** 3%)

7. The desire for "wining the reward" could drive some users to overlook how data is gathered and to whom it is exposed. This makes some users, at times, vulnerable.
   (**SA:** 23%, **A:** 44%, **N:** 15%, **D:** 18%, **SD:** 0%)

8. Ethics in gamification could be seen analogous to those in marketing, i.e. gamification could make some tasks attractive to users who would not ethically like to perform without gamification.
   (**SA**: 13%, **A**: 46%, **N**: 33%, **D**: 8%, **SD**: 0%)

9. Gamification, in certain cases, could mean trying to get from people more than what their job requires, i.e. using gamification as an exploitation-ware.
   (**SA:** 26%, **A:** 38%, **N:** 13%, **D:** 23%, **SD:** 0%)

10. Ethics should be seen case by case and even at the level of individual users, e.g. the same game mechanic for the same task may be seen differently from ethical perspective according to the user.
    (**SA**: 18%, **A**: 50%, **N**: 26%, **D**: 5%, **SD**: 0%)

11. Freedom of Information: Users' ability to see what is stored about them is an ethical issue.
    (**SA:** 38%, **A:** 44%, **N:** 10%, **D:** 8%, **SD:** 0%)

The experts' comments in the open-ended survey questions from Chapter 4 were also analysed to obtain further insights which will be reported along with the findings of the study with managers and employees in this chapter.

- DM and tension at workplace (1, 2, 3)

- DM as a monitoring mechanism (3, 4)
- DM and privacy (4, 5, 6)
- Using DM as “exploitation-ware” (7, 8)
- DM and its relation to personal and cultural values (9, 10, 11)

5.2.1 Digital Motivation and Tension at Workplace

Following the studies conducted with the managers and employees with regards to ethical concerns in the design of DM systems, this section reports the findings on potential effects of DM from the perspective of tension at workplace.

The Nature of Working Environment.

Nature of the environment where DM is applied to has a vital role in making it a source of tension, and sometimes relief. The results show that implementing DM in a collaborative environment may have an adverse impact since it can create an unnatural competition and thus tension; “it is like competing with each other, instead of working with each other”. In a collaborative environment, it will have a negative impact on the relationship amongst employees as it is going to be against their ordinary and everyday practice and there is also the danger of people heavily comparing themselves with each other, which is not what they need to do for the success of a collaborative project. In BISs where competition is natural, e.g. a call centre, this effect of DM should be acceptable as the competition is already in place.

Tasks

Nature of the task and the job is another deciding factor whether DM will lead to tension on individuals and also in their relationships. By analysing the responses, it appears that a primary attribute of a task, which matters here, is whether it is a collaborative or a competitive task regardless of the nature of the work environment. Furthermore, DM seems to suit tasks where the outcomes are measurable, which are objective and tasks done separately by a group of people. If the tasks can be measured, for example, tasks in a sales environment, then it is more likely that it will not create or increase tension since it will provide employees with a system that showcases their efforts. Applying DM for subjective tasks may lead to tension since the points or scores achieved might not reflect the actual effort that was put to the task. Applying DM, especially points, when doing different tasks could lead to more tension as "some may have easier tasks than others [so they get more points], and also the scores may not reflect how much effort employees have put to get the job done".

Age

The age of employees also seems to be a major factor that influences the degree of tension DM creates amongst employees. Participants observed that older generation employees might not like to work in environments where DM is applied, as they are accustomed to traditional means over time, and will be under pressure to learn the new technology and know in certain cases how to adjust their work style to get the best of it.

Employee's Personality

Depending on employees' personality, DM can be perceived differently. The achievements may make some of them arrogant, or on the other hand, they may start to be helpful and try to train others. Some of them might be competitive and like it, while some "might just get stressed by thinking about it". Personality traits are a key factor. Extroverts typically like showing their achievements, e.g. sharing their badges which reflect their performance and they typically like to appear in the leader-boards. On the other side, introverts are sceptical about exposing this information to colleagues. Forcing them to participate, could put tension on them and lead to reduced productivity and affect their social and mental well-being at the workplace.

The Management Style

In certain managerial styles, e.g. highly hierarchical and centralised management styles, DM could lead to stressing people by creating the fear of being frequently questioned. The concrete nature of information collected by DM makes it easy for managers to evaluate employees, e.g. being able to see if certain employees are constantly at the bottom of the list helps the argument when questioning their performance. Also, it appears that managers could use the collected information to compare employees with each other and create competition for promotions, which could be seen as another source of tension. However, some managers use the data differently for improving employees' weaknesses without comparing them to each other, which will not introduce tension to the work environment.

Employees' Ranks

Employees' ranking, when concretised via DM amongst other colleagues, is generally seen as a source of tension. This is especially the case for those who are not performing as well as top employees, "If you appear in the leader-board, you are fine, but if you are not, you may feel depressed, [and] you may be judged by your boss as well". It is also concluded that applying DM to rank people could have an adverse impact on employees' relationships, decreasing the teamwork and creating the danger of people comparing themselves to each other instead of focusing on their original work, since "those who are below their peers will feel pressurised". Decreasing teamwork could mean more competition and as a result, more tension, especially amongst employees with a genuine collaborative personality. On the other side, using ranks could also increase teamwork when DM is designed in a way that it encourages collaboration amongst team-mates, e.g. when ranking is applied to the team instead of the individuals.

Clusters Amongst Employees

DM could lead to creating clusters of employees, i.e. those who are similarly performing could group together. This could be negative as “it will create winners and losers in a team”, and there is the fear that those who are not performing as well as others will be requested to leave the team since they are deteriorating the overall team performance. This, in turn, can increase the tension amongst employees with lower performance. An interesting observation is that there are always clusters in organisations anyway regardless of the use of DM. DM will just extend what is there now, and it will only reinforce what is there as “you do group with people of your own type naturally”. However, clustering based on DM is not necessarily negative as “it may create unity in a team, [since] it can group people [with similar talents] together” so they do things better together and complement each other. Such increase in teamwork, as stated before, can decrease competition and thus tension amongst employees.

Table 5.1 summarises the findings of the factors that can introduce tension into the working environment and clarify the fine line between the questionable use of DM and the use which is likely to be acceptable from ethical perspectives.

5.2.2 Digital Motivation as a Monitoring Mechanism

DM can be seen as a monitoring system since it captures work information. It is emphasised that monitoring performance is a common practice at enterprises. The difference is that DM has the potential to do that in a very detailed and concrete way

Table 5.1 DM vs. tension at workplace

	Tension-Problematic	Tension-Acceptable
Working Environment	Collaborative	Competitive
Task	Not Measurable	Measurable
	Non-uniform	Uniform
	Subjective	Objective
	Collaborative	Competitive
Age	Older generation	Younger generation
Personality	Non-competitive	Competitive
	Introverts	Extroverts
Management Style	Comparative appraisal	Individual appraisal
	Destructive criticism	Constructive criticism
Rank	Rarely top performing	Regularly top performing
	Individual competition	Group collaboration to win
Clustering	Fear of being isolated	Talent-based grouping

and store performance information in a digital database subject to all kinds of queries and data analytics. In some cases, it may even capture sensitive personal data, e.g. the analysis of the webcam to conclude an employee's mood and mental status and reflect that on the avatar representing that employee. Thus, DM as a monitoring mechanism does not raise legal issues; it is just stronger than human monitoring in certain aspects. The perspective of privacy on this will be discussed in another section. The analysis of the findings in this chapter identified four areas in which DM used as a monitoring system could raise ethical issues:

The Wide Visibility of Employees' Ranks in Enterprises

Leader-boards can be visible to everyone in an organisation. Therefore, they could be perceived as a monitoring system, allowing employees and managers to monitor the progress, points, and ranks of others. It appears that employees may not like to have such a monitoring system available in their workplace, given that many of them will not appear as top performers. On the other hand, top performers embrace this feature as they can showcase their progress to other colleagues and especially managers. Top performers are recognised in traditional monitoring and appraisal systems but to a less frequency and visibility than it is the case with DM.

Level of Details

Some participants mentioned that employees might have various productivity levels during working hours, referred to as “highs and lows”. DM can easily collect such patterns through points and their time-stamp giving managers the opportunity to monitor their employees in more details. Employees preferred to have control over how they performed the task, only making their final results visible to the managers. This way, their lows would not be exposed, and employees would not feel they are being spied on. However, when detailed information about employees’ highs and lows were captured and stored by the system, they would feel uncomfortable and under pressure to have a consistent performance.

The Nature of Tasks

Monitoring in general and the fine-grained way of monitoring, in particular, put pressure on employees when doing tasks requiring creativity and time needed to accomplish them cannot be predicted. In addition, there are times when DM-based monitoring does not reflect the actual nature of the task. In a sales environment, for example, some of the employees may argue that although they have sold less, they have obtained more loyal customers for their company, or that they have done a higher quality task, or that they are “more than just numbers“. It can be deduced that monitoring certain tasks by the digital metrics of DM is not enough to base the judgement on how employees are performing it. DM can capture how much work is done but is limited in capturing how effective it is performed especially for tasks when quality is a primary requirement.

The Management Style

The ethical use of DM as a monitoring system depends on the way managers would use gathered information to deal with their employees. No matter what information is stored or what the nature of the task being performed is, employees could be fine with this monitoring system as long as they felt that managers would use it to help them improve without comparing them to others, and not use it to "squeeze them with the same pay". Furthermore, DM as a monitoring system is capable of spotting if there is a problem or not, but cannot interpret what the problem is and why it is happening. Therefore, when managers rely purely on DM in this aspect, it may lead to misinterpretation of what is really going on. Managers should keep a direct contact with the employee to discuss what the issue is to avoid the deceiving nature of DM data. This is especially the case in big and highly centralised and hierarchical organisations where there is not that much of interaction between higher levels of management and employees, making DM as a monitoring mechanism a source of pressure and unfairness.

The Employees' Personality

Monitoring is not necessary a bad mechanism for certain people. DM could be used as a self-monitoring tool for employees as well. Some employees might be interested in knowing how they are performing in comparison to others, using it as a self-motivator to improve their performance in their workplace. However, in addition to the nature of the task and the management style, personality traits could play a key role here, as employees who are not genuinely interested in the job and who are "looking for promotions and just want to do the job" may never perceive monitoring in such positive way.

Table 5.2 summarises the findings of factors related to DM as a monitoring mechanism and how likely they are to raise issues in the working environment.

Table 5.2 Monitoring mechanism factors vs. their perception

	Likely to Raise Issues	Likely to be Accepted
Rank Visibility	Not in the top list	In the top list
	Frequently shown to all	Occasionally shown to all
Level of details	Fine-grained details	Overall performance
Nature of Task	Creative	Classical
	Quality-based	Quantity-based
Management Style	No direct contact	Direct contact
	Pressurising for more productivity	Improving self-productivity
Personality	Doing the task as any job	Genuinely interested in the task
	Moderately ambitious	Ambitious and self-motivated

5.2.3 Digital Motivation and Privacy

As a counterpart of monitoring, privacy is seen as a primary concern when using DM. The concerns were centred on the following categories:

What is Being Stored?

Storing personal information seems to be a major concern for employees at work. There is a fine line between storing work-related information, e.g. when one starts working, and personal information, e.g. how angry an employee in a call centre is by analysing the calls to change the avatar, the status, or to reduce points. Another aspect here is that the stored information should be objective facts rather than judgements subject to different interpretation. Storing the time taken to solve an issue is an example of a stored objective fact. Storing that an employee is tired or lazy recently because of the long-time was taken is a case of the latter.

Who Can See the Information?

A consensus was observed that the information stored about employees should not be available publicly. One reason for it was that people do not like others to see their weaknesses and sometimes their unique areas of expertise they typically use to promote or be recognised over time. This privacy concern is lighter since this information is available to managers as a manager can access that by law although it is different from the digital style of DM. Another view is that it could be accepted if relevant colleagues, especially when working as a team, have access to such information, still based on clear organisational rules. Another factor to consider is the privacy as in some countries having this information publicly available is illegal. Consequently, the use of an anonymised or translucent leader-board could be an effective idea. By using an anonymised leader-board, employees will know how well they are doing in comparison to the top performers, but they are not aware of who exactly is above or below them on the leader-board.

The Employees' Personality

Typically, hard-working, competitive and ambitious employees will be less worried about privacy issues related to their performance information obtained by means of DM. This would be even seen in a positive light and it will give them a voice amongst colleagues and would justify their request for promotions or bonuses. On the other hand, some others may not like their information to be available publicly because they do not like the competitive atmosphere. This does not necessarily mean that they are not hard-working employees; it only means that they do not enjoy working in a competitive environment.

The Right to View Information

Participants agreed that employees should have the right to see what is being stored about them, and information obtained by means of DM is not an exception. In essence, under the Freedom of Information Act in some countries, people should be legally given this right. However, it stays in the grey area whether employees can also see what assessment is done by the managers based on these data. This is clearly hard to track but still important for employees to know the underlying principles of how that works.

Table 5.3 summarises the findings of factors related to privacy issues in DM and how likely they are to raise issues in the working environment.

Table 5.3 Privacy vs. employees perception at workplace

	Likely to Raise Issues	**Likely to be Accepted**
Stored Information	Personal, or likely to lead to infer personal information	Work-related information
	Subjective judgement	Objective facts
Information Accessibility	Public/Non-relevant peers	Managers/relevant peers
	Real names	Anonymised or translucent
Personality	Introvert	Extrovert
	Non-competitive	Competitive
	Ambitious	Happy where they are
Right to View Information	Actual collected data are hidden	Data are available

5.2.4 Digital Motivation as "Exploitation-Ware"

When interviewing experts in DM in the exploration phase in Chapter 4, the term "exploitation-ware" was mentioned. The term refers to the use of DM to motivate staff to do more than what their job requires (Nicholson, 2012). They could do that to achieve more points and scores, which could occasionally lead to increase in salary and promotions, or just to avoid having a low rank or modest status. Investigating this further, this ethical aspect of DM depends on a number of factors summarised in the following.

The Strategy of Rewarding

The tendency to consider DM as an "exploitation-ware" increases when the reward strategy depends on the relative performance of an employee with respect to others in the workplace rather than being dependent on the individuals' performances. An example of this is when the top-ten performers get a higher salary while the rest, who still tried their best, are not rewarded. This means a rewarding strategy, which gives everyone a certain amount of reward reflecting their extra performance and quality, would reduce the perception of DM as an "exploitation-ware". The design of a tempting reward mechanism which attracts many but can be ultimately achieved only by very few employees is likely to raise exploitation issues.

The Nature of Reward

The nature of the reward also has an effect on the perception of DM as an exploitation-ware. Intangible rewards, such as being on the leader-board, do not cost enterprises directly and could still drive employees to work harder than what their job specification requires. Thus, intangible rewards could be viewed as an exploitation of the social environment at the enterprise and peer-pressure to get more outcomes without any tangible sacrifice from the management and owners.

The Transparency of Rewarding Policy

The transparency on how the rewarding system works is also essential to make DM more ethical from exploitation perspective. For example, if managers explain how points will be translated to promotions on an objective basis, this makes things more ethical and moral. At times, this is not an easy decision to make, and managers tend to do that on a case by case basis, depending on the role, the individuals, and their progress. Thus, the problem might not originate solely from transparency but also from the ability to concretise and quantify the rewarding strategy.

The Perception of the Traditional Version of Rewarding Mechanism

This aspect is related to the extent to which the rewarding strategy imitates the rewarding procedure enacted in the enterprise, without DM, and how these procedures are seen from an ethical perspective. When the underlying reward strategy is ethically accepted, then its automated or digital version is unlikely to be seen differently. For example, if in certain enterprises a draw is conducted to choose one of the top performers to receive a gift is a well-accepted practice in the enterprise, digitalising it is unlikely to raise ethical issues. If such a procedure is seen as bringing lottery and gambling to the work environment and trivialising the work and fairness principles, then a digital form of it would still raise similar ethical issues.

Employees' Personality

DM could be seen as an "exploitation-ware" when involving a certain type of people who would accept intangible rewards and value them in an exaggerated way. For example, those "ultras" in using online mediums may find their main lives there, and there is a probability of them valuing a nicer avatar more than a salary increase in certain cases. This might raise an ethical issue that DM could exploit their extreme desire to win "just" virtual rewards. A similar observation is made on those who are socially isolated in the traditional world and would like to compensate in the environment that DM creates by elements like having better ranks, status and avatars. Enterprise management should ensure that a personality test to discover such an extraordinary perception of virtual rewards is handled beforehand.

Table 5.4 summarises the findings of factors related to the perception of DM as an exploitation-ware and when it is likely to raise ethical issues from that perspective.

Table 5.4 DM as exploitation-ware

	Likely to Raise Exploitation Issues	**Likely to Reduce Them**
Rewarding Strategy	Comparing to others progress	Outcome-based
Nature of the Reward	Intangible costs	Tangible costs
Policy	Non-transparent	Transparent
Tasks	Non-concrete/ Subjective	Concrete/ Objective
Underlying Mechanism	Seen negative	Seen acceptable
Personality Type	Online “ultras”	Balanced
	Looking to compensate online	Balanced

5.2.5 Digital Motivation vs. Personal, and Cultural Values

In the interview phase in Chapter 4, one of the experts raised the issue that DM and the desire to win, as an underlying concept, could lead to employees acting against their personal and cultural values. For example, in a call centre, an agent would tolerate the language of an angry customer to get the points of solving the issue. In practice, some industries even give extra points to those who succeed to calm down the angry customers. Thus, some agents would become wishing to have a call from such customers which is a desirable change of behaviour but perhaps not what the agent would like in standard settings. This point was further investigated in the next two phases of the study and came up with the following observations.

Value-sensitive Design

It is generally agreed that people’s characteristics and attitudes rarely change by whatever digital game mechanics are used in the enterprise. Thus, DM per se is not a reason that people behave in a certain manner including their behaviour against their values and beliefs. DM is just a facilitator. However, being a facilitator does not mean that DM developers, and enterprise managers adopting it, are free of responsibility. DM, especially for the “digital-native” generation, could be a very tempting medium which could highly facilitate acting against personal and cultural values. Misalignment with employee's values and beliefs might affect their social and mental well-being at the workplace. This shows the importance of the value-sensitive design of DM as an information system (Friedman et al., 2013).

Sacrificing Quality Standards

DM could drive people, who usually do things to the best quality as part of their work ethics, to do things in a cursory manner. They may not be happy to do that, but a reason for that could be the fear of being out of the game and losing their community recognition when techniques like ranks, status, and leader-boards are applied and designed in a way that do not recognise and acknowledge the quality of work.

Cheating to Win/Survive

Similar to the previous point, the desire to win, and also the fear of being in the bottom of the list, could drive people to cheat and do the tasks in a way which would contradict with their own values. For example, in a DM case study in the education sector, students took a screen shot of time-based quizzes in their first attempt, solved the problems in their spare time, and answered the quizzes correctly in their next try and got higher marks (O'Donovan et al., 2013).

The Value System Within the Enterprise

The value system within the enterprise is also a major factor affecting the decision whether certain game mechanics are ethical enough. For example, in BISs where tasks are intellectual, competition could have an adverse impact. Similarly, progress bars could be seen as inferior options when the tasks are sensitive and require patience, e.g. when applying it for the receptionists of a hospital.

The Culture of the Place

A similar observation could be made with regards to the culture of the place where the enterprise is based and where the majority of employees belong. In certain cultures, showing off is seen as a violation of the norms and conventions of acceptable public behaviour. This means the leader-boards might be considered in a negative light if applied in such a culture and might put those who appear in it under pressure.

Table 5.5 summarises the findings about factors related to DM versus personal and cultural values and how it relates to ethical issues.

Table 5.5 DM vs. personal and cultural values

	Raise Ethical Issues	**Likely to Reduce**
Value Sensitive Design	Not-aligned with personal values	Aligned with personal values
	Force to participate	Participation is an option
Quality Standards	Drive people to be fast	Quality first
	Create clear competition	Soft competition
Honesty	Difficult to win	Everyone can get something
	Consequences on loosing	No serious consequences
Enterprise Norms	Aligned with enterprise norms	Not-aligned with enterprise norms
Culture of People	Consistent with the place's culture	Contradicted with the place's culture

5.3 Chapter Summary

This chapter has investigated the debate regarding the ethical issues that DM could cause within enterprises. DM could be seen as an unfair mechanism to increase productivity with no real costs, i.e. via playfulness. In addition, it could increase pressure on employees to achieve more or avoid being in the bottom of the list. DM might contradict with some personality types and cultural norms.

Chapter 6

Digital Motivation and People: Archetypes

The results and analysis provided in Chapter 4 and Chapter 5 suggest that people have diverse requirements, preferences, and perceptions about various approaches that DM uses to motivate them with regards to their social and mental well-being within BISs. Despite the importance of involving people in the design process for successful DM solutions, this involvement has its own implications and costs which stem mainly from the high diversity in users' preferences of such a highly personal requirement. Based on John and Srivastava (1999), people can differ from each other in five aspects of their personality. Hence, a high number of distinct personalities and their preferences on motivational elements of DM exists. As a result, it is difficult to design a DM setting that can satisfy every single person and meet their preferences. To tackle this issue, this chapter studies and advocates the use of personas (Cooper et al., 1999) to create a starting point in the design of DM and also decrease its design costs.

The concept of persona is rooted in marketing (Cooper et al., 1999) and is used as an interactive design tool to model users' requirements in the process of software development (Moore, 2002; Pruitt and Grudin, 2003). As a user-centred design

(UCD) approach, Cooper et al. (1999) advocates the use of personas in shifting the focus of the design towards the end-users of the software system and their requirements. Cooper defines personas as fictional characters that each of them can describe different types of users and their requirements through ethnographic and empirical analysis of the actual end-users of the software system. Also, Idoughi et al. (2012) mentioned that personas try to model the user and point out their outstanding characteristics, goals, and requirements. To give life to the fictional personas, usually, they are assigned names, age, gender, photos, and jobs.

This chapter aims at empirically investigating the use of personas in the design of DM and provide a set of constituents necessary for the creation of personas with regards to various settings of DM. This set of constituents can help DM designers and analysts to study the actual end-users of DM in a BIS and shape possible personas based on the available population of the end-users. The resulted personas can aid DM designers and analysts to obtain a fairer idea of end-users requirements and preferences with regards to the design of DM and result in a more acceptable artefact from the perspective of end-users.

6.1 Chapter Methodology

This chapter has conducted empirical investigations to identify aspects of DM that can influence end-users' social and mental well-being within workplaces and determine the constituents which shape personas with regards to DM. Facilitating the findings in previous chapters, a list of various aspects of DM which users' indicated divergent opinions on them had been identified. Initially, an empirical study focusing on end-users' personal preferences and their views on the identified list with regards to DM was conducted. This study performed semi-structured interviews with ten employees.

Participants received the research information sheet informing them with the aims and objectives of the study and a consent form, indicating their willingness to participate in the study, their ability to withdraw from the study at any time, and stating that their voice will be recorded for transcribing purposes. The age scope of the participants varied between 24 and 37 years old, consisting of four females and six male participants with a balanced academic and industrial experience. The interviews aimed at eliciting end-users' preferences and priorities on different settings that DM could offer. Participants provided their priorities and opinions about various settings of DM. Moreover, they provided actions they may take where applicable, e.g., decreasing the quality of their work just to receive points. The results of this part of the study, along with the rest of the findings from previous chapters, helped in shaping the persona constituents necessary for structuring and developing personas. Furthermore, six different personas were created and used in the next phase of the study. The full set of the questions used in the interview sessions is available at Appendix C.

The interviews resulted in 373 minutes of voice recording, with 20 minutes being the minimum length and 61 minutes the maximum duration of interviews. The interviews were transcribed, and two researchers analysed the content. Once a disagreement emerged between the two researchers, a third researcher was involved in mediating the decision.

Finally, ten psychologists were asked for their opinions regarding the created personas. This part of the study focused on identifying if the created personas seemed realistic to the psychologists with regards to DM and users' preferences related to social and mental well-being within the workplace. All psychologists received an explanation of the personas and the persona constituents in details. The psychologists have studied the personas for one week and then reflected their opinions after. Their feedback was used to analyse and enhance the persona constituents and the created personas.

6.2 Personas for Digital Motivation

Identifying the aspects and properties of DM which can affect the social and mental well-being of its users is necessary before performing the qualitative phase of developing personas. By further analysing the findings in previous chapters and an additional user study in this chapter, the important constituents from the end-users' perspective were identified. These constituents are described in the following and illustrated in Fig. 6.1. This section provides users' views on various properties on DM and their social and mental well-being within BISs. The discussion is structured using Fogg (2002a) persuasive model. Furthermore, this model is used as a baseline for the identification of personas constituents which will aid in the development of personas with regards to the social and mental well-being of the users, as illustrated in Fig. 6.1.

6.2.1 Persuasive Tools and Social and Mental Well-being

This subsection describes how persuasive tools can affect the social and mental well-being of the users of DM.

Tunnelling and Reduction

An instance of tunnelling and reduction in DM techniques is goal setting. It means that users are given pre-defined and step-by-step instructions to perform certain tasks. It enables users to monitor their progress by collecting information regarding the advancement of each step. Users have shown various opinions towards tunnelling. Some users liked the idea and stated that it would ease their job. They found it helpful to have decisions already made for them. However, some found this feature of tunnelling and reduction to be restrictive and stated that "it will make me work like a robot". These users were interested in having the freedom to choose how to perform their tasks instead. Moreover, some others showed interest in having

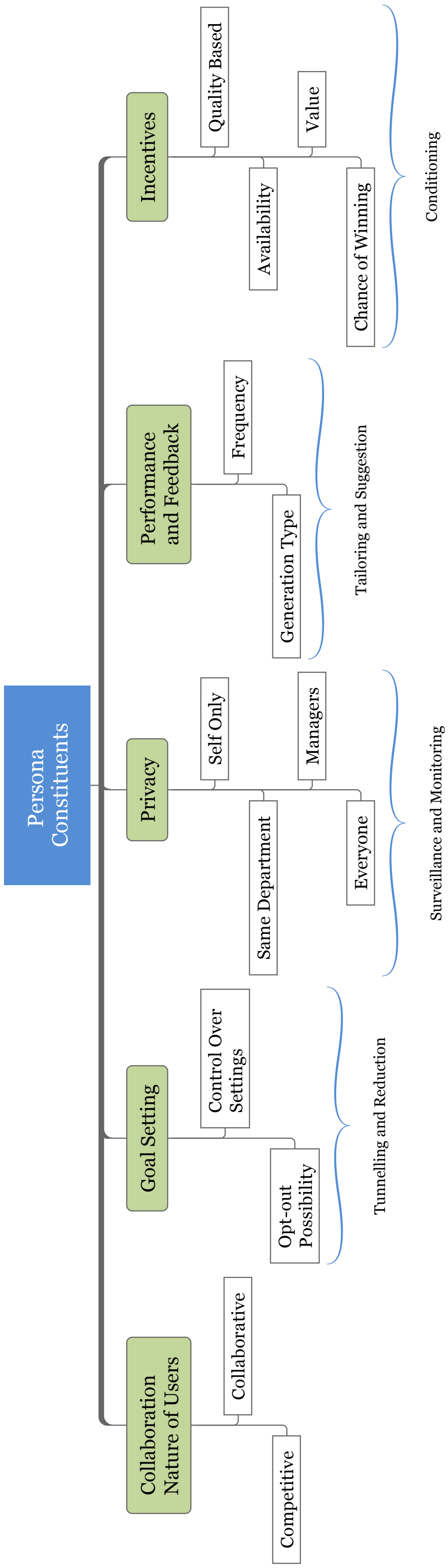


Fig. 6.1 Persona constituents

the steps towards achieving the goals, if given the freedom in defining the steps. Users had various opinions on the monitoring aspect of this mechanism. This was of interest to some users as this would inform them in case their task is dependent on another. Some others were worried their managers using this as leverage to make them work more.

Tunnelling and reduction require information related to the performance of its users. Users found this aspect to have an impact on their perception regarding DM being a source of pressure or stress. A primary concern was the frequency of updating. Some users wanted to know about their progress status, reflected by points, instantly. They found it stressful to wait for a period to figure out how many points they have achieved. Some others preferred longer intervals, from one-day interval to weekly updates. “It will kill the joy if I get the points instantly, I want to feel accomplished when I am done with my task”. Others also mentioned that they preferred to have the element of surprise, and receiving all the achievements at the end of the week would provide them with such element and give them more motivation.

Tailoring and Suggestion

A typical example of tailoring and suggestion is the feedback provided to the users. Feedback is generally an analysis on the performance of users in a period of time. Feedback can be generated algorithmically, by means of a computer or can be created for individuals through managers or people with authority. Users had different opinions on this feature of DM with regards to their social and mental well-being within their workplace. Some preferred human generated feedback over computer generated one. They believed that a computer cannot understand and take into account circumstances in humans’ life. Therefore, users thought this could be a source of pressure as they cannot describe to a computer the origin and cause of problems. On the other hand, some preferred a computer generated feedback as an algorithm cannot have a bias. This assures them of a fair feedback. Otherwise, they worry if “managers have [subjectively] favoured another employee over them”. Another aspect being important for users is the frequency of receiving feedbacks. Various frequencies were of interest to users. Some found more frequent feedback to be useful and helpful, stating “if I am doing wrong, I prefer to know it soon, so I have time to fix it”. Some others found less frequent feedbacks to be useful and less stressful.

Conditioning

This refers to introducing incentives and punishments for the users. Incentives could be virtual goods such as badges that DM gives to users or could be tangible rewards such as gift cards. Moreover, a negative reinforcement could be in place to prevent unwanted behaviours. Despite being motivating, having a negative reinforcement by itself is a source of pressure and stress. However, positive reinforcement can be demotivating or even a source of the issue if not aligned with the preferences of users.

As such, the rewarding strategy was of importance for users. An aspect of the reward that concerned all users was the relativity of the reward with the effort needed to achieve it. Some preferred to have a higher chance of winning, even if it means reducing the value of the prize. They did not find a significant prize appealing as they found it hard to achieve. It was mentioned by some users that “same people are going to win the prize anyway, what is the point of even trying”. On the other hand, some users stated that it is not fair for the first place winner to receive a reward the same or similar to the 20th place. They preferred to have a reward with high value available. “I want to receive a reward that reflects my efforts”.

Surveillance and Self-monitoring

DM collects various forms of performance data. It is considered as surveillance in Fogg's model when managers, peers, or others within the workplace have access to all, or part of the collected data. It is also considered as self-monitoring when the users themselves use the performance data to track their progress or achievements.

People had different perceptions of such feature, and some of them said that they would quit and will not tolerate such characteristics in their workplace. As a part of performance evaluation and appraisals, managers have access to the performance information of employees in classical working environments. However, in contrast to periodic reviews, some found it a source of stress if DM could provide managers with real-time information. Users found various aspects of DM as a monitoring mechanism to be influential in their preference regarding their social and mental well-being within their working environment. A proportion of users found it motivating to compete with other peers and have access to each other's information as a result. Some others preferred an inner-group competition and wanted the information to be available to peers from same departments. Some others preferred to have information available to themselves and managers only. Moreover, a proportion of users had no issue if only their general information was available to others, i.e., their strengths and skill points.

6.2.2 Personas Constituents

This subsection provides the findings of constituents that are important and need to be taken into account in the process of creating personas.

Collaboration Nature of Users

This is a contextual constituent that needs to be considered prior to the design of DM and personas. It refers to the preferences of users on whether to compete or collaborate towards achieving certain goals. In this study, some users showed interest in a strategy that promotes competition and individualism. It was stated that “I am a competitive person, I seek competition”, for these users, a collaborative approach would be a source of pressure as they showed concerns about situations where they have to “pull others weights” and do others’ job for being able to stand out in the crowd. On the other hand, a proportion of users showed interest in collaborating with others to achieve their goals. “I don’t like to compete with others in my work, it will definitely increase the tension in the environment”. Some other users were interested in a strategy that promotes both collaboration and competition, e.g., in a leaderboard where groups of employees collaborate to win as a team. “I don’t like to compete with everyone in my working environment, but I will enjoy a friendly inner-group collaboration [to win as a group]”. Finally, to some users, having a short-time contest, for instance, a competition in the training course was exciting. However, a long-term competition in the workplace could be “too much of tension”.

Incentives

DM can provide tangible and intangible incentives and rewards to motivate its users. From the perspective of users, several important aspects may influence their motivation and perception. Users were concerned about the relativity of the reward with the efforts needed to achieve it and the possibility of winning the reward. Some expressed that a reward low in value will not motivate them to put their best efforts to achieve it, stating that “if I am the first in the list, I want to win big, I don’t want a small prize for being the best in work”. On the other hand, some expressed that they preferred to have rewards lower in value, but higher in number to have a higher chance of winning. “A big prize is motivating, but after a while, I will just give up. A certain number of people are going to win all the time anyway. I think it is better to have a higher chance of winning, however, the prize should still mean something to me for the effort I need to put". It was mentioned that providing a combination of high, medium, and low-value incentives for the users could be an appealing solution as it can cover the preferences of all users from this aspect.

In addition, some wanted the assurance that the quality of their work is considered in processing their achievements. Others were worried that involving a human in processing their achievements can produce bias. Therefore, they preferred to know how many points they will achieve for accomplishing a task. Moreover, some showed interest in having the element of surprise for their achievements. They found it motivating and fun to have the feature of obtaining hidden achievements. "If someone has something that I do not have, it will definitely motivate me to go and explore to achieve it." However, this view was not shared amongst all users, as some of them stated that it could make working as a game, and some found it as a source of stress and tension. "I do not mind if others achieve something and I did not, but if they start to show off their achievements, I do not like it."

Privacy

One primary concern of users, with regards to their social and mental well-being within their working environment, was their privacy. Many had concerns regarding their privacy being violated as a result of DM. Even some users interested in competing with other peers were worried about people who can have access to their detailed work information. Depending on the context of the information, people showed different concerns and preferences. To an extent, some users had no issue regarding their general working information being available to all in the working environment. These users were mainly competition seekers. Moreover, some collaborative users found it helpful if it will help others to find them regarding their strengths and skills if the information reveals only this kind of information. Regarding the information being available to peers in the same department, users had different views as well.

Some found it interesting as it would create the inner-group competition that they were seeking. However, a majority of users were concerned that the information being available to peers need to be general enough that does not reveal users detailed working information, i.e., their work routines. Furthermore, a majority of the users agreed that the managers already have the right to access the information captured employing DM, it was mentioned that the information should be their general working information. To some extent, a proportion of users showed concerns about their managers having access to detailed information about how they are working and stated that "I may want to take it easy on some days and work harder on other days. I don't want my managers to have access to this information; this is very stressing, I will feel that I have to constantly work".

Performance and Feedback

DM provides reporting features to managers and users which are enabled by collecting data from users performance. Users showed concerns on how this feature is configured. One of the concerns was regarding the frequency of updating the report. There have been various views on this aspect of DM. Some users found real-time reporting to be motivating, "I want to see how many points I have received for what I have done", whereas some others preferred less frequent updating of the report for various reasons, i.e., "real-time update will kill the joy of finishing the task for me", or "I like to know about my performance at the end of the week, it creates an element of surprise for me to wait and see how I have done at the end of the week". For the feedback generated from these collected data, besides the frequency of receiving feedback, users were concerned about the way the feedback is generated. Some preferred computer generated feedback. They found it to be less vulnerable to bias as a computer cannot have a bias towards other users. Some others preferred to have the feedback to be generated by a human, i.e., the manager, as a person can "tailor the feedback for each user" and consider circumstances that caused a failure or a special success.

Goal Setting

DM can be used to break down the tasks for users to guide them through the path to achieve the ultimate aim. Although some users showed interest in being given the exact steps needed to perform a task, a considerable proportion of users found it demotivating and believed that this would threaten their social and mental well-being as it gives a feeling of working like a "robot". Some users stated that they would like to have the feature of setting steps towards achieving the goals if the steps are as guidelines only or they have the freedom and control and can define the actions themselves.

6.3 Developed Personas

At this stage of the research, the proposed persona constituents illustrated in Fig. 6.1 were followed to develop a set of personas. This should help better understanding of how these constituents can be adopted in the design process of developing DM in BISs. Empirical studies of this research provided us with the information necessary for developing a set of personas according to the preferences of the participants with regards to the social and mental well-being of them when using DM within their workplace. In general, some found specific properties of DM interesting and encouraging, and some others found the same settings to be of no use or a source of stress. Therefore, personas were created that each could represent a type of person that actual users of DM could relate their preferences to, regarding their social and mental well-being within the workplace. In the end, six personas were developed and enhanced. The personas are summarised in Fig. 6.2 and the full description of personas can be found in Appendix C.

Creation of personas for the design of DM with regards to the social and mental well-being of its users aims at identifying groups of users with similar personalities and preferences. Thereupon, a customised setting of DM can be mapped to each identified group. This contributes to the BIS to satisfy preferences of different groups of people. It is noteworthy that this research does not advocate a fixed, final set of personas. Various factors, such as environment changes or technological advances, may result in a need for an update in the present personas in any BIS. Furthermore, the appearance of new personalities in the BIS or changes in people's preferences may create the need for adding a new persona to the system. Software designers need to use the identified personas to create respective system behaviours that fulfil the preferences of personas. Users can be mapped to a persona that is more relevant to their preferences and has a system behaviour assigned to them as a default setting with the possibility of altering the assigned setting.

All Personas in Details

- **Mary**

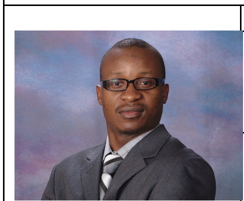
  Overall statement: Mary is a collaborative, hard-working, privacy sensitive person. She doesn't appreciate elements introduced by DM and does not find them motivating.

  [Preferred method] Mary finds it more encouraging to know how many points she is going to receive when she performs a task. She always tries to perform with the highest quality and earning points does not mean a lot to her, and she will keep working as normal. **[Privacy preference]** She is OK with the points to be available to her managers only as she thinks they are the decision makers and the ones who will assess her performance, and there is no point in letting others know about points you have received. **[Collaboration nature]** She likes to collaborate with others and likes to achieve points on a group

Name: Ben	**Age**: 28	**Gender**: Male	**Job**: Programmer
Overall statement: Ben enjoys competing with the people he knows and are doing similar jobs. It is important for him that the quality of his work is considered in the software-based motivation. He is an explorer and likes to have surprises in his work. He likes to share his achievements with the people he knows and have a friendly competition with them. It is important for him to win big at the end, he thinks that it is not fair for the top winners to receive the same prize as the others.			
Setting: Method (Conditioning, Tailoring, Suggestion, Tunnelling), **Privacy** (Detailed Info: Managers, Self – General Info: Peers, Managers, Self – Progress Info: Peers, Managers, Self), **Collaboration Nature** (Competitive), **Performance** (Real-time), **Feedback** (Human generated, Monthly), **Incentive** (Higher Value, Lower Chance)			

Name: Clara	**Age**: 31	**Gender**: Female	**Job**: Data Analyst
Overall statement: The quality of work is important for Clara, however, it is important for her to not fall behind her colleagues. Therefore, she may decrease the quality of her work if she can receive the same points. She is an explorer and wants to have surprises in her work. She is concerned about her detailed work details, however, she finds it helpful for others to be able to access her skills set.			
Setting: Method (Conditioning, Tailoring, Suggestion), **Privacy** (Detailed Info: Managers, self – General Info: Everyone – Progress Info: Managers, Self), **Collaboration Nature** (Collaborative), **Performance** (Weekly), **Feedback** (Human generated, Monthly), **Incentive** (Higher Value, Lower Chance)			

Name: John	**Age**: 48	**Gender**: Male	**Job**: Accountant
Overall statement: John is a collaborative person who finds elements introduced by software-based motivation interesting, he likes to share his detailed working information with his relevant colleagues and his skills with everyone within his workplace.			
Setting: Method (Conditioning, Reduction, Tunnelling, Tailoring), **Privacy** (Detailed Info:Managers, self – General Info: Everyone), **Collaboration Nature** (Competitive), **Performance** (real-time), **Feedback** (Human generated, weekly), **Incentive** (Higher Value, Lower Chance)			



Name: Mark	Age: 42	Gender: Male	Job: Technology Analyst
Overall statement: Mark cares about the quality of his work and will not decrease the quality if he can get points with lower quality. He is collaborative and doesn't like social recognition. He will keep his points low enough so that he does not attract any attention to himself.			
Setting: Method (Reduction, Tunnelling, Tailoring, Conditioning), **Privacy** (Detailed Info: Managers, self– General Info: Everyone, Progress info: self), **Collaboration Nature** (Competitive), **Performance** (real-time), **Feedback** (Human generated, Monthly), **Incentive** (Lower Value, Higher Chance)			

Name: Paul	**Age**: 41	**Gender**: Male	**Job**: Recruiter
Overall statement: Paul does not like software-based motivation, however, if he has to use it, he will get very competitive in order to do his best and be amongst the winners. He just wants to be told what he has to do and doesn't like to make decisions.			
Setting: Method (Reduction, Tunnelling, Tailoring, Conditioning), **Privacy** (Detailed Info: Peers, Managers, self – General Info: Everyone), **Collaboration Nature** (Collaborative), **Performance** (real- time), **Feedback** (Computer generated, daily), **Incentive** (Lower Value, Higher Chance)			

Name: Mary	Age: 24	Gender: Female	Job: IT Engineer
Overall statement: Mary is a collaborative, hard-working, privacy sensitive person. She doesn't appreciate elements introduced by software-based motivation and does not find them motivating.			
Setting: Method (Reduction, Tunnelling, Tailoring), **Privacy** (Detailed Info:Managers, self – General Info: Peers, Managers, Self), **Collaboration Nature** (Collaborative), **Performance** (real-time), **Feedback** (Human generated, weekly), **Incentive** (Lower Value, Higher Chance)			

Fig. 6.2 Summarised list of created personas

basis rather than individually. She believes that in a professional environment, everyone will work and no one will be pulling anyone else's' weight.

[Discouragement] Mary does not appreciate receiving virtual badges, as she believes that those who should know about her abilities already know it. She thinks that it will encourage her to pretend to be someone she is not to achieve a certain badge. **[Privacy preference]** However, she thinks that if there are badges, they can be available to her relevant peers as this does not carry detailed information about how she works. **[Discouragement]** She also does not like to explore for badges and likes to know about all possible badges that can be achieved and how they can be attained. Mary also does not like to appear in a leader-board, however, if there is one available, she wants to have a leader-board of relevant colleagues only.

[Preferred method] to fulfil her goals, she likes to be told what steps are needed to be taken. Having this steps and information about their fulfilment available to relevant colleagues, she believes that this can help finishing the final task with better quality.

[Performance and feedback preference] She likes to know about her achievements on a real-time basis. However, she wants to receive daily or weekly feedback which is created by her manager rather than a report made by a computer. She believes that managers can feel the work, but a computer can't.

[Incentive preference] She also believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

- **John**

  Overall statement: John is a collaborative person who finds elements introduced by DM attractive, he likes to share his detailed working information with his relevant colleagues and his skills with everyone within his workplace.

[Preferred method] John likes to receive pre-defined points for the tasks he is performing. He believes that if managers are going to give the points, his focus from work will be shifted towards satisfying his managers and this will eventually increase his stress at work. **[Collaboration nature]** John doesn't like to be compared with all employees within his workplace. However, he enjoys an inner-group competition. **[Privacy preference]** He finds it motivating to have points available to relevant colleagues. That is why he wants to have a leader-board that only promotes competition amongst relevant colleagues.

[Preferred method] John likes the idea of badges, and he finds it less personal than points. **[Privacy preference]** Therefore, he likes his badges to be available to everyone within the workplace. Others can also use the badges and find his skills and ask for his help when they need. **[Motivation]** John finds it motivating and exciting to have some hidden badges. He likes to explore new things and believes that this will change his job to become routine.

[Preferred method] John likes to be told the steps he needs to take to achieve a goal. However, he wants to be able to choose how to perform those given sub-tasks. **[Privacy preference]** He believes that the information about the progress on the sub-tasks should be available to everyone who is working on same projects. Others may be waiting for a task to be finished, and this will help them to know when the work is likely to be finished.

[Performance and feedback preference] John likes to receive his achievements on a real-time basis. However, he wants to receive weekly feedback generated by his manager rather than the computer. He believes that humans are not robots and it is necessary for managers to assess their performance and not rely on a computer's report only.

[Incentive preference] He believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

- **Paul**

  Overall statement: Paul does not like DM, however, if he has to use it, he will get very competitive to do his best and be amongst the winners. He just wants to be told what he has to do and doesn't like to make decisions.

  [Motivation] Paul does not like the idea of DM. However, if he finds himself in such a system, he will fight for it. He doesn't promote competition, but if he has to do it, he will do his best to be in the top performers.

  [Preferred method] Paul likes to receive pre-defined points. He believes that managers can get biased or not recognise the quality of his work. But if the points are pre-defined, then he is sure that there was no misjudgement. **[Privacy preference]** He believes that if the points are available to his managers only, he will continue as normal, but if others can see his points, he will do his best to be amongst the top performers. As long as his relevant colleagues can see his points, he will not be stressed, but if it is going to be available for everyone, he finds it stressing. **[Collaboration nature]** He also wants to receive points on an individual basis. He believes that earning points on a group basis will not represent his actual effort, others may not work as hard as he is working.

  Paul does not like to have a leader-board in the environment, but if there is any, **[privacy preference]** he wants it to be available to everyone. He believes that a leader-board shows only how many points you have achieved and where you reside amongst everyone else. It doesn't show detailed information about you.

  [Preferred method] He likes the idea of badges, however, he wants to know exactly how many badges are there and how they can be achieved. **[Discouragement]** He believes if someone has a badge that he doesn't, it puts pressure on him to receive that badge, and if he fails to do that, he will feel frustrated, and this will decrease his quality of work in general.

[Preferred method] He wants to be exactly told what to do, without freedom of choosing how to perform. He believes that this will keep the consistency of the work and ensures the quality of the final product. He believes that choosing how to carry out a major task is a challenging and stressful job.

[Privacy preference] Paul thinks that the information related to the progress of these sub-tasks should be available only to those who are linked to the tasks and no one else.

[Performance and feedback preference] Paul wants to see the result of his performance and achievements on a real-time basis. He also believes that at the end of the day, a computer generated report should tell him how well he did. He doesn't want the managers to assess his works; he believes that humans are biased and can have mistakes in their judgements.

[Incentive preference] He believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

- **Mark**

  Overall statement: Mark cares about the quality of his work and will not decrease the quality if he can get points with lower quality. He is collaborative and doesn't like social recognition. He will keep his points low enough so that he does not attract any attention to himself. **[Preferred method]** Mark believes that points should be calculated according to the quality of his work. He will not decrease the quality of his work just to get the points if the points were pre-defined, but he finds it fairer if the quality was measured. **[Collaboration nature]** He also likes to collaborate with others and does not like competition. **[Privacy preference]** He is fine with the points to be available to his relevant colleagues as long as they do not show off their achievements. In that case, he limits the visibility to managers only if he can. He has no appreciation for social recognition but likes to use DM as a self-monitoring mechanism.

[Preferred method] Mark doesn't like to explore and have surprise badges. He wants to know how many badges are available and how they can be achieved. **[Privacy preference]** It is OK with Mark for his relevant colleagues to have access to his achieved badges as long as there is no showing off.

[Preferred method] Mark likes the idea of having an anonymous leader-board in his working environment. It can help him monitor his performance. **[Discouragement]** But he thinks that it is very stressful to have a leader-board that compares real individuals with each other. He doesn't even like to appear in a leader-board, and if he appears in a leader-board and others talk about it to him, he will keep his points at a point that his name is removed from the leader-board.

[Preferred method] He likes to have pre-defined sub-goals. It helps him better understand how the task should be performed. **[Privacy preference]** But he only wants the information about the progress to be available to him. Not even his managers. **[Discouragement]** He believes that it will give very detailed information about his work habits and if managers have access to such information, will make him change his working habits, and he finds it very pressuring.

[Performance and feedback preference] He likes to see the achieved points on a real-time basis. However, he doesn't want the managers' opinions to be provided to him anything sooner than monthly, or even a feedback to be given after the task is finished. He likes to have the human touch in the feedback, he believes that a computer cannot feel his work.

[Incentive preference] He believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

- **Clara**

Overall statement: The quality of work is important for Clara, however, it is important for her to not fall behind her colleagues. Therefore, she may decrease the quality of her work if she can receive the same points. She is an explorer and wants to have surprises in her work. She is concerned about her detailed work details; However, she finds it helpful for others to be able to access her skills set.

[Preferred method] Clara wants to receive points according to the quality of her work. **[Discouragement]** Otherwise, she will be motivated to decrease the quality just to earn the points. **[Collaboration nature]** She also likes to collaborate with others in achieving the goals. **[Privacy preference]** She only wants her points to be available to her managers only, and she finds it stressing if it is available to others.

[Preferred method] She likes the idea of having some hidden badges in the environment and **[privacy preference]** she wants her virtual badges to be available to everyone as it is not that much personal. It shows her skills and others can use them to find her when they need help in an area that she is strong.

[Preferred method] She is fine with having a leader-board that **[privacy preference]** only shows relevant colleagues and promotes a friendly inner-group competition. **[Discouragement]** Having a leader-board available to everyone will make her to be quick which will decrease the quality of her work at the end.

[Discouragement] Clara doesn't like to be told how to achieve a goal. She likes to be able to decide how she is going to perform. She believes that defining the steps towards achieving a goal will remove creativity. **[Privacy preference]** However if she can decide and set the tasks she is going to perform, she prefers the information about her progress to be available to her managers only.

[Performance and feedback preference] Clara doesn't like a real-time update of her achievements. She believes that this will kill the joy of finishing a task. She wants to see her achievements at the end of the week. In addition, she believes that feedback is better to be created by managers as they can tailor it to individuals, and she likes to receive the feedback from her managers on a monthly basis.

[Incentive preference] She believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

- **Ben**

  Overall statement: Ben enjoys competing with the people he knows and the those who are doing similar jobs. It is important to him that the quality of his work is considered in the DM. He is an explorer and likes to have surprises in his work. He likes to share his achievements with the people he knows and have a friendly competition with them. It is important for him to win big at the end, he thinks that it is not fair for the top winners to receive the same prize as the others.

  [Preferred method] Ben wants to receive points according to the quality of his work. He believes that it is unfair to have pre-defined points for the tasks. The quality of the task is missing in that situation. **[Collaboration nature]** Ben likes to compete with others from his own department. He likes to have the points available to his relevant colleagues.

  [Preferred method] He likes to have hidden badges in the environment, He likes the element of surprise that this mechanism introduces. **[Privacy prefer-**

ence] He likes the badges to be available to his colleagues from his department, he finds it pointless to have it available for someone he doesn't know.

[Preferred method] He wants to have a leader-board that shows his relevant colleagues, it will motivate him to work harder to appear on the leader-board. However, he finds it irrelevant for others from different departments to be compared with each other in the same leader-board.

[Preferred method] He likes to have the sub-tasks given to him as guidelines, but he likes to be free on how to perform the tasks. **[Privacy preference]** He finds it too personal for others to access on the progress he is making in achieving a task, however, if his task is related to others, then he think its a rational decision to make it available for them.

[Performance and feedback preference] He wants to have his achievements to be available to him on a real-time basis, however, he wants his managers to see them on a weekly basis. He also likes his managers to assess his work and give him feedback, but he doesn't want to receive frequent feedback. Once in a month is what he would be fine with. He likes it when he can use this DM as a daily basis self-monitoring mechanism.

[Incentive preference] Ben believes that there should be a limited number of prizes, but bigger in amount. He thinks it is not fair for the first person to receive a prize which is relatively similar to the prize for 20th person.

6.4 Personas in Action

In this chapter, a scenario is used to illustrate how personas can help software designers to identify a setting of DM aligned with the preferences of personas. In this scenario, a software engineering company has decided to use DM to increase its employees' motivation. Next, the situation with the constituents which are important for users is analysed. Finally, the personas of Mary and Ben are used to propose settings of DM that is aligned with the preferences of the personas.

6.4.1 Scenario

A software engineering company is trying to increase motivation in their employees. In this company, the HR department works closely with all departments and line managers to make sure that policies are being followed. They also administer payrolls, maintain employees' records, and undertake regular salary reviews. They are responsible for recruitment and analysing training needs.

The marketing department assures that the company is following the trends and is not behind the competitors regarding offering new technologies and products.

The development team is responsible for understanding the customers' needs and deliver a web product according to what customers are seeking. It is important for them to deliver the projects on time, with sound quality, and also meet the requirements of the clients.

The company decides to use DM to increase employees' engagement and motivation. To this end, the company will start to give points to employees for the tasks they successfully finish. These points can represent the performance of employees and can be used in monitoring employees' performance with higher accuracy. A leader-board will be introduced to illustrate the top performers in the company according to the received points. Also, based on the achieved points on various areas of expertise, employees can earn badges when they master specific skills. Moreover, a progress bar is going to be introduced. This will help others to keep track of tasks they are relying on as well as individuals and managers to use it as a monitoring mechanism. The progress bar needs to have tasks broken down into several sub-tasks to make it feasible. In addition, some tangible incentives will be provided for employees in order to increase their motivation and engagement. Finally, the HR department, in conjunction with the managers, will use the features of DM to give feedback to the employees and also decide whether an employee should get a promotion or not.

The company is hoping for a fairer decision on promotions and an increase in employees' productivity, engagement, and quality of work after this DM is added to the environment.

6.4.2 Analysing the Environment

This section analyses each DM element that the company is trying to introduce by the use of constituents provided in Fig. 6.1.

The company is trying to introduce DM elements, such as points, virtual badges, leader-boards, progress bars, tangible incentives, and feedback. The important aspects for each of these items are analysed in the following.

Points could be considered the core of DM as most of the other elements rely on the information gathered by this element. There are a few aspects of the points that have to be taken into account before this element is applied to a user. One important aspect of this element for some users is the method used to give points to employees. It should be considered that some users prefer to have a human touch in the assessment of their points and have the quality of their work considered while earning points. Some others prefer to have it pre-defined and generated by computers only to prevent biases that humans may have in their decision making processes. Another important aspect of the points is the visibility of them to other employees. Some would agree for their points to be visible to others. However, some others may only decide to make it visible to certain people in their environment.

Virtual badges are a favourite element in the application of DM. They mainly guide the way employees need to perform, e.g., for training purposes, or represent the strengths and skills-set of employees in various areas. Various strategies may be used for giving badges to employees. A company may provide virtual badges for employees by making them available and known to all, with guidelines on how they can be achieved. In addition to these available badges, the company may decide to provide some hidden badges to add the element of surprise and excitement to the working environment. To achieve these hidden badges, employees need to explore and try different actions to gain them. Another important aspect for some users related to the badges is the visibility of achieved badges to others. Some would have no problem for others to access their achieved badges, and they may even find it helpful, i.e., in finding people based on their skills-sets, while some others may find it as a source of stress.

Leader-boards are one of the highly used elements in DM. This element tries to list top performers of an environment based on their performance. Leader-boards can follow different strategies. Primary concerns of users are focused on the competitive nature of such element and the privacy issues it may create. Some users may find it motivating and helpful. Some others may find it motivating, but at the same time, they may be concerned about their privacy. Some others may not like the competitive nature of such element and dislike its presence in the environment. One other concern is the frequency of updates and also the time intervals a leader-board uses to compare employees with each other.

Progress bars are mainly used to track the performance and progress of a user on a task. This element requires the target task to be broken down into sub-tasks and collects information about the status of these sub-tasks performed by the user. A progress bar may be used and set differently. It may force its users to follow pre-defined sub-tasks and monitor the performance of these sub-tasks. On the other hand, users may be given the freedom to choose their subtasks and choose how they want to fulfil their goals and given tasks. Also, it is important for some users to know who can access their progress bar and how often it is going to be used. On the other hand, some users may need to have access to another user's progress bar in case of a dependency relation between some tasks.

Tangible incentives could be considered as a strong motive for people. However, various people have different preferences on receiving incentives. There are several aspects of tangible incentives that can affect how people perceive them. Some are more interested in prizes high in value. However, it may mean lower chances of winning for everyone. On the other hand, some others find it demotivating and prefer to have higher chances of winning and lower value prizes. Also, it is important for some users to have a transparent decision making policy and know how the decision on choosing the winner(s) is made.

Feedback given by managers or HR to employees about their work performance can be directly affected by the use of DM. The nature of DM demands to collect work-related information about employees, and it can give accurate and precise information about the work performance of employees to the managers and HR department. Feedback can be generated in a classic way that is by managers or can be just a performance report of how a user performed based on the information gathered. Feedback can have different frequencies; it can vary from a daily basis feedback to weekly, monthly, or longer periods of time. People have different preferences on how they want to receive feedback, from mere computer generated to a mixture of human and computer-generated feedback, and from daily feedback to less frequent feedback.

6.4.3 Designing the Settings for Personas

By using the constituents introduced for personas, it is now possible to analyse and see how the setting of DM should be adapted to each persona. This chapter uses the personas of Mary and Ben to explain the setting of DM that is aligned with each persona's preferences and to discuss the challenges of having these two personas in the environment. The final configuration of motives for Mary and Ben are illustrated in Fig. 6.3 and Fig. 6.4.

Mary

Mary considers herself a collaborative hard working person. She is sensitive about her privacy and does not agree to compromise her privacy to obtain virtual or monetary goods. However, if DM is a part of her work routine, there are some preferences she has over the settings of DM.

Mary will not decrease the quality of her work just to receive some points quicker. However, she likes to know how many points she will receive prior to starting a task. She does not like the points to be calculated by humans and prefers *pre-defined* points for tasks. She thinks humans may have biases while assessing her performance.

As she is sensitive about her **privacy**, it is important for her who has access to her information captured by means of DM. She does not have any problem with her *managers and HR department* to have access to her points, as she considers them to be the decision makers. However, she finds it of no use for others to access her information and thinks it is meaningless.

Since she considers herself a collaborative person, a competitive setting of DM may cause tension and stress in her. She believes that in a professional environment, everyone will work as expected and a collaborative environment does not mean others will have to do another's job. Therefore, a leader-board may not be a useful tool to motivate her with respect to her social and mental well-being at her workplace since it is competitive and reveals information about the performance for a larger audience.

Mary does not appreciate receiving virtual badges as she believes that those who should know about her abilities already are aware of them. She also believes that virtual badges may encourage her to pretend to be someone she is not just to achieve certain badges. However, in case the presence of badges are a part of the system she is working in, she is tolerant of her badges to be available to her *relevant peers only*, as badges do not carry detailed information about how she works. She finds it a breach to her **privacy** if someone from the Marketing department could have access to her badges. In addition, she does not like to explore for new badges, and if achieving badges is a part of her work, she wants the *full* availability of all badges and to know how each of them can be attained.

Mary shows interest in the goal setting feature of DM and the progress bar. She believes that knowing the steps that should be taken to fulfil a task is helpful, and the progress bar will help others to manage their times especially when their tasks rely on each other. However, she thinks that if the tasks are not relevant to some employees, then they should not have access to the progress status of her task. For instance, if the Marketing department is waiting for a task Mary is performing to be finished and prepare a report of the status to the client, Mary finds it reasonable for employees from Marketing to have access to her progress bar. However, she wants to be assured that *not everyone* from the Marketing department has access to her progress bar and it is limited to the *relevant employees* to the project only.

She is interested in knowing about her achievements, e.g., points or badges on a *real-time* basis and also likes to receive as **frequent** human generated feedback as possible. She wants the feedbacks to be *generated by her managers* and the HR department as they can feel the work whereas a computer is only following numbers and algorithms. She wants it to be *more frequent* as she finds it helpful in detecting her mistakes and improving her abilities with a faster pace.

Finally, Mary prefers to have a *higher chance of winning*, although it may mean that the **value** of the rewards will decrease due to this setting. She thinks that it is more motivating to have a *higher* chance of winning as not everyone can become a top performer in a working environment.

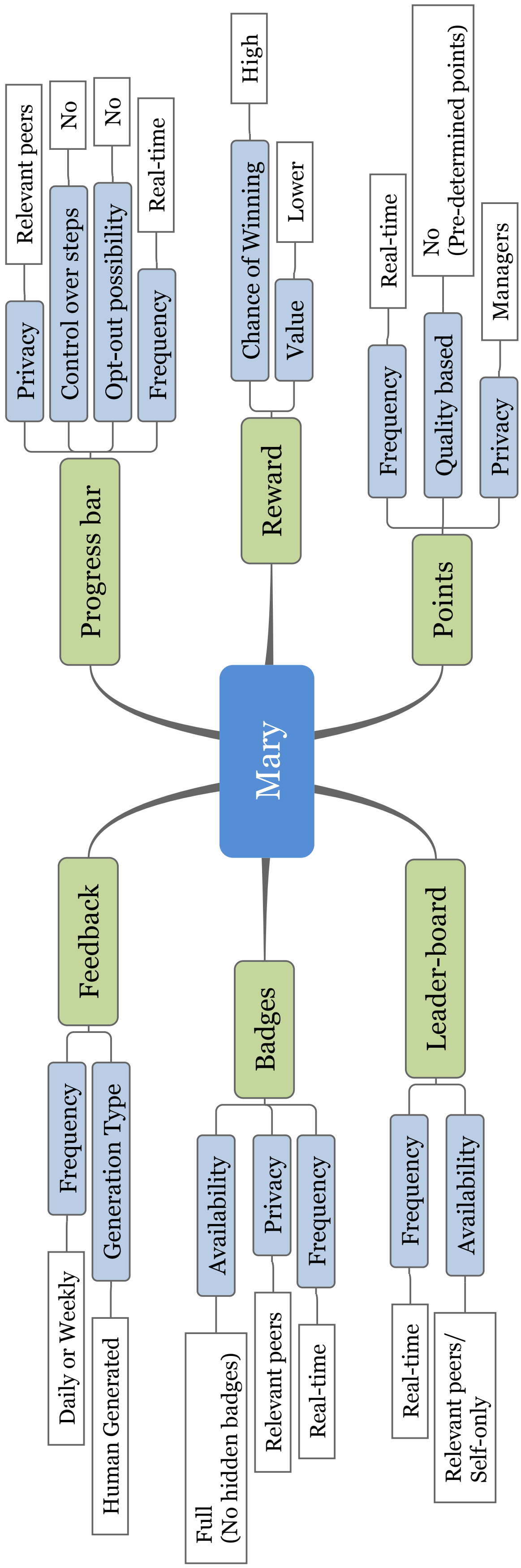


Fig. 6.3 Digital motivation settings for Mary

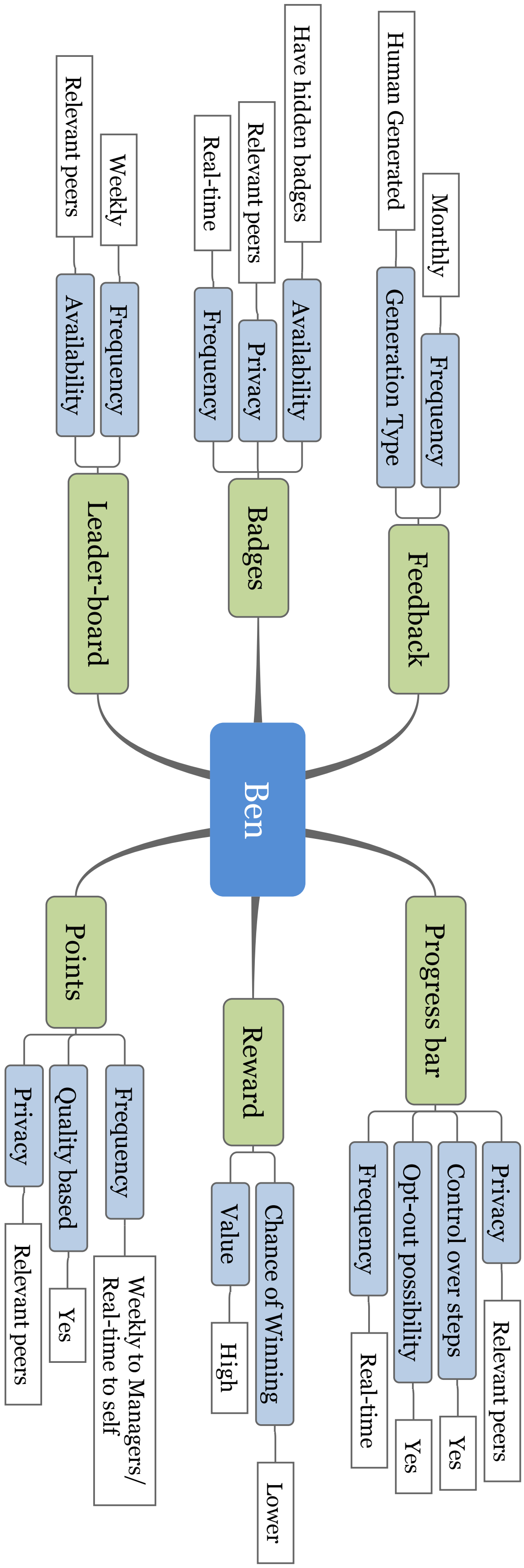


Fig. 6.4 Digital motivation settings for Ben

Ben

Ben enjoys competing with people he knows and those w are doing a similar job. It is important to him that the quality of his work is considered in the DM. He is an explorer and likes to have surprises in his work. He wants to share his achievements with the people he knows and have a friendly competition with them. It is important for him to win big at the end; he thinks that it is not fair for the top winners to receive the same prize as the others.

Ben wants to receive points according to the **quality** of his work and wants a human touch in the calculation of the points he is receiving. He believes that it is unfair to have *pre-defined* points for the tasks regardless of the differences in the quality of outcome. He believes that quality of the task is missed in such situations and this will drive people to decrease their quality of work just to receive the points.

Ben is *not much sensitive* about his **privacy** as long as he finds those accessing his information *relevant*. He finds himself a competitive person and likes to share his points with his *relevant colleagues* to fulfil his sense of competition. This will make him work harder to appear in the leader-board. Therefore, a specific leader-board for his department where all *relevant employees* compete would be of his interest. However, he finds it unnecessary if people from other departments, such as marketing, have access to his points or the leader-board.

Ben likes the idea of receiving badges for his skills or as a guide for training. He also finds himself to be an explorer and enjoys having an element of surprise and fun in his work. Therefore, he prefers to have some *hidden* badges that he is not aware of their presence. From a **privacy** point of view, he only wants his achieved badges to be available to his *relevant colleagues* and he thinks it is useless if someone from the Marketing department can see his achieved badges. He thinks that if an employee from Marketing needs to find someone with particular skills-set, they need to ask his manager rather than being able to find him directly via his profile.

Ben thinks that it is helpful if there is a feature that enables a progress bar showing the status of his progress for specific tasks. However, he shows concerns about various aspects of this feature. He wants to be able to **opt-out** and do his work without the progress bar if he finds it as a source of stress and pressure. Then, he wants to be able to have **control over the steps** and choose the sub-tasks by himself and have the freedom of deciding how he wants to achieve his goals and finish his tasks. He finds it working like a robot if he is told what to do and how to complete certain tasks. He believes that progress bars carry detailed information and wants the progress bars to be available to *relevant peers* that is only those whose work rely on the fulfilment of the task he is working on. Since progress bars can help others to estimate when they can start their work, he does not find a *real-time* update of the progress bar as a source of pressure and stress.

With regards to the **performance and feedback** that Ben receives, he prefers to have access to the information about his performance on a *real-time basis*. He finds the self-monitoring feature of DM helpful and appealing. However, he prefers an accumulative performance of *a week* to be available to his managers and the HR. He finds a *real-time* access to his performance by his managers and HR to be intrusive since it is possible for them to extract his working habits through the information. For the feedback, he thinks that a *monthly human generated* feedback can be helpful as a month is enough time for him to prove his abilities. Also, one month gives him sufficient time to find his weaknesses and try to improve them before it is already late.

Ben believes that there should be a limited number of rewards, but *higher* in **value**. He thinks it is not fair for the person with the highest performance to receive a prize which is relatively similar to the prize for the 20th person. It will be demotivating for him, and he will not try to become the best in this setting.

6.5 Personas for Digital Motivation Design: Challenges

Despite the benefits of using personas in the design of DM, developing and using them introduces some challenges. These challenges are selecting a representative sample of the users' population, eliciting users' preferences, developing personas based on the collected information, variations in personas preferences, and the evolution of DM. These challenges are described in details as follows.

6.5.1 Selecting a Representative Sample

In the medium to large scale BISs, it is expected to have a significant number of users. Therefore, it is not a practical solution to analyse the preferences of all users in the environment. One solution to this issue is the use of population sampling. Population sampling refers to the selection of a sub-set of users from the population to estimate characteristics of interest for the whole target population (Salant et al., 1994). Several methods try to help in selecting a sample which can contribute to achieving results closer to reality (Lohr, 2009). This could be a crucial stage, as a good sample, which is a representative of the population, can lead to a better design of personas. On the other hand, failure in selecting a representative sample can result in missing a considerable proportion of users preferences.

6.5.2 Eliciting Preferences

Eliciting users' preferences is an important phase of the design. Since users may not know precisely what they want, it is important for the software designers to know what they should ask users to elicit reliable, actionable, and related preferences of the users with regards to the design of DM. To tackle this problem, section 6.2.2 elaborated on important aspects of DM that users may have different views on, with regards to their social and mental well-being within their workplace. These constituents can shape the questions that software designers need to ask from users to elicit proper and actionable preferences.

6.5.3 Developing Personas

Developing personas on its own is a challenging task, and there is no one-size-fits-all approach available for creating personas (Mulder and Yaar, 2006). However, it is believed that to develop personas, designers need to aggregate elicited data about the users into an actionable and meaningful story (Spool, 2007). These can be achieved by following certain guidelines (Mulder and Yaar, 2006). In general, this guideline suggests performing an empirical study, segmenting users into identifiable clusters according to their elicited preferences on DM, and developing personas for each segment.

6.5.4 Variations in Personas Preferences

Another challenge in employing personas in the design of DM is to design settings of DM for each persona. There are several challenges ahead of the design process, e.g., conflicts in the preferences of users with each other, or conflicts in the preferences of the users with the business goals of the BIS. It is difficult to satisfy the needs, requirements, and preferences of all users within a BIS. Designers need to provide settings of DM that balances between these conflicts and provide acceptable solutions for users. Failure in accomplishing this challenge can lead to adverse results, e.g., not satisfying business goals, ignoring the social and mental well-being of a proportion of users, or creating a new source of tension and pressure without resolving the conflicts.

Although the preferences of users on DM are personal, some motives, e.g., leaderboards and rewards, impact users in a collective way and need to be designed with extra care so that preferences of involved users are not violated. In the following, some issues that may occur as a result of these variations in the preferences are presented.

- **Tangible rewards:** Preferences of Ben and Mary are different regarding how to receive a reward based on their performance. By following the setting of tangible rewards for each persona, the other persona is demotivated and will find the reward inaccessible (when Mary's preference is ignored) or of no value (when Ben's preference is ignored). Therefore, a setting should be followed that enables the fulfilment of both preferences where possible. In this case, the company can provide both high-value prizes in a few numbers and lower value prizes but in a higher number. However, it should be taken into account that the lower value prizes should be adjusted with the efforts needed to achieve them. Failure in providing a prize in accordance with the effort required for its achievement will not motivate users to increase their productivity.

- **Leader-board:** Mary finds herself to be a collaborative person and Ben likes to compete with his colleagues. Leader-board is a competitive motive and it needs to be designed carefully. None of the personas like a public leader-board for every employee of the company and find it unhelpful. However, Ben is interested in having a leader-board in his department so he can prove himself as a hard working person, whereas Mary wants to avoid leader-boards and competition as much as possible.

  The company can make a decision on not using leader-boards as it may create stress and tension on Mary. However, this option will eliminate the chance of motivating Ben to a great extent. Despite this issue, the company can choose for an alternative design of the leader-board, which is adding the option of anonymity to the leader-board. This means that those who do not want to appear in a leader-board can choose to do this, and only their points will be issued on the leader-board with their names anonymised. This setting can be used as a self-monitoring mechanism for Mary, without exposing her performance to others and creating the unwanted competition. Moreover, Ben will benefit from this setting as it will satisfy his passion for competition with those who agree to appear on the leader-board.

6.6 Chapter Summary

This chapter argues that users' preferences and requirements are key elements to the design of DM in BISs. Therefore, empirical studies were conducted with the aim of determining and identifying elements from DM in which end-users find influential in their preferences of a DM design. As a result, this chapter proposed a set of persona constituents which aids DM designers and analysts in studying the end-users and helps in shaping clusters of personas which can represent a considerable proportion of preferences and requirements of end-users. Hence, a more acceptable design of DM amongst its end-users is expected.

Chapter 7

Conceptualising Digital Motivation in Business Information Systems

This chapter aims at conducting a further investigation on findings in previous chapters and provide a set of constituents that shape a DM system in a business context. Having these constituents beforehand paves the way for a systematic approach towards designing DM. A systematic approach, amongst other things, could introduce various benefits, such as a better requirements elicitation, a more precise compatibility and conflict analysis, and a more sustainable design.

To achieve this goal, various characteristics of the motives and their compatibility with those goals and tasks they are meant to support need to be considered carefully. Furthermore, there is a need for considering the social actors who are subject to the desired behaviour change and their roles and interrelations.

This chapter aims at providing a thematic mapping to support a systematic integration of the concept, within its organisational ecosystem at the early stages of software engineering, i.e., requirements engineering. The results are meant to aid software engineers in the analysis and design of DM that is effective, sustainable, and compatible with the rest of the enterprise. In addition, this chapter tries to propose a requirements-driven conceptual architecture for an integrated and holistic engineering framework.

7.1 Results

This section conducts a further analysis on the findings of this research to this end and reports and reflects on the results. Here, the constituents that shape DM and its users' requirements and preferences are provided.

7.1.1 Digital Motivation: Elements and Properties

Various elements, properties, and aspects of enterprises can influence the development of DM to increase productivity and keep the social and mental well-being of the actors at the desired level. A thematic analysis of the findings following the six stages as recommended by Braun and Clarke (2006) helps to form three thematic areas that could assist in determining constituents that influence the perception of DM amongst its actors. There are three aspects in enterprises with DM implemented in them that can affect the perception of employees about DM. Identifying attributes related to these aspects can help achieving a more preferred design of DM by employees. These attributes relate to the tasks that DM is being applied, the rewards that are being introduced, and the information it is capturing. An initial thematic analysis of these findings is depicted in Table. 7.1.

This chapter further enhances the thematic mapping illustrated in Table. 7.1, through further iterations and identifies overlapping concepts and reduces them into fewer distinctive attributes, e.g., the tasks in the initial thematic mapping were reduced from six attributes to three, and more concepts and attributes were identified and added to the thematic mapping, which resulted in forming two distinct thematic areas that can influence the preferences and perception of DM amongst employees

Table 7.1 Initial thematic map for conceptualising digital motivation

<table>
<tr><td rowspan="18">Motivation</td><td rowspan="3">Reward</td><td colspan="3">Policy</td></tr>
<tr><td colspan="3">Nature</td></tr>
<tr><td colspan="3">Strategy</td></tr>
<tr><td rowspan="6">Tasks</td><td colspan="3">Uniformity</td></tr>
<tr><td colspan="3">Measure-ability</td></tr>
<tr><td colspan="3">Subjectivity</td></tr>
<tr><td colspan="3">Standard</td></tr>
<tr><td colspan="3">Nature</td></tr>
<tr><td colspan="3">Values</td></tr>
<tr><td rowspan="9">Captured Information</td><td rowspan="4">Visibility</td><td colspan="2">Everyone</td></tr>
<tr><td colspan="2">Relevant Colleagues</td></tr>
<tr><td colspan="2">Managers</td></tr>
<tr><td colspan="2">Self-only</td></tr>
<tr><td rowspan="3">What is Stored</td><td colspan="2">Personal Information</td></tr>
<tr><td rowspan="2">Work Related Information</td><td>Detailed Information</td></tr>
<tr><td>General Information</td></tr>
<tr><td rowspan="2">Element</td><td colspan="2">Competition</td></tr>
<tr><td colspan="2">Collaboration</td></tr>
</table>

in a BIS. The two main themes derived from the findings are the *environment* and *motives*.

7.2 Towards a Systematic Approach for Digital Motivation Design

This research has tried to understand digital motivation in details and identify concepts and constituents that shape it. As a result, thematic maps related to important aspects of the BIS and DM which have an impact on the design of DM were proposed. These thematic mappings provide critical focus on constituents necessary for modelling motivation requirements in a BIS, which paves the way for a systematic approach towards designing and implementation of DM. Since an ad-hoc development and implementation of DM into a BIS may fail to achieve its design goals and have detrimental side effects, a systematic approach towards its design and implementation may help to reduce the risks.

One advantage of a systematic design and implementation of DM into a BIS is the consistency in eliciting stakeholders' motivation requirements. This consistency is accomplished by providing the aspects of BIS and DM that stakeholders find important and believe these aspects can have an impact on their perception of the design of DM for the BIS. Moreover, a rigorous systematic approach and a motivation model can enable analysing situations which are not possible or difficult to analyse in more complex BISs. Utilising an expert system and a recommender system can enable automation of the analysis phase if the need is sensed. Despite the advantages of having a rigorous modelling methodology, the literature in the field of DM lacks an engineering approach that considers the business goals of the BIS and users' motivation requirements, which leads to the ad-hoc design approaches.

Following extensive literature study on the relevant fields of DM and various empirical studies, in addition to the technical aspects of DM, this research advocates the consideration of the organisational structure and social interactions in a BIS. Thus, this study aims at building a framework and modelling language that can describe the socio-technical structure of a BIS and build on that to enhance it to enable a better understanding of DM and its introduction to a BIS. Goal oriented modelling languages provide some of the social and technical concepts necessary to model DM and the business environment it is being applied. Hence, this research builds on top of a goal-oriented modelling language and extends it in a manner that can help achieve a more acceptable design of DM amongst its social actors.

This modelling language, Digital Motivation Modelling Language (DMML), enables a systematic design and implementation of DM and paves the way for automated analysis using the models drawn using DMML. DMML consists of various fragments. First is a meta-model describing all the constituents necessary for a systematic design of DM and the relations amongst the constituents. Second is a formal specification defining the language in the form of mathematics. Next is a graphical representation of the constituents and relations amongst them described in the meta-model and the formal specification. The rest of this chapter is structured as follows. The first section tries to provide a holistic understanding of DMML, introducing modelling constituents and their relations that are followed by the formal specification of DMML in mathematical form. In the next section, the meta-model for DMML is presented which provides an abstract understanding of the modelling language. In the fourth section, graphical representations of the constituents and the relations are presented which enables drawing of a model for a system as-is or a system-to-be. Finally, in the last section, the modelling language is used to analyse various motivational requirements in different cases that DMML can help detect conflicts and issues which were not possible or were difficult to detect prior to the use of DMML.

7.3 DMML: Digital Motivation Modelling Language

DMML aims at helping BISs to engineer motivation requirements. The goal of DMML is to provide a DM for BISs aligned with the business goals, workplace culture, and workforce preferences. To achieve this aim, DMML relies on information from the working environment in the BIS and the motives being introduced to this environment. DMML can model the system as-is in addition to system-to-be, for separate reasons. Modelling the system as-is provides the ability to analyse the current situation of a BIS for any incompatibility of the DM implemented in the BIS. Also, modelling the system-to-be enables examining the context and the situation of a BIS and provide it with possible solutions which could aid the business to achieve its goals regarding increasing motivation and engagement of the workforce.

Table 7.2 Thematic mapping for conceptualising the environment

<table>
<tr><td rowspan="23">Environment</td><td colspan="3">Actors</td></tr>
<tr><td colspan="3">Values</td></tr>
<tr><td rowspan="3">Tasks</td><td colspan="2">Uniformity</td></tr>
<tr><td colspan="2">Measure-ability</td></tr>
<tr><td colspan="2">Quality-oriented</td></tr>
<tr><td rowspan="4">Relations</td><td colspan="2">Role Role Task</td></tr>
<tr><td colspan="2">Task Task</td></tr>
<tr><td colspan="2">Task Role</td></tr>
<tr><td colspan="2">Role Role</td></tr>
<tr><td rowspan="14">Persona</td><td rowspan="4">Incentives</td><td>Quality based</td></tr>
<tr><td>Availability</td></tr>
<tr><td>Value</td></tr>
<tr><td>Chance of Winning</td></tr>
<tr><td rowspan="2">Performance and Feedback</td><td>Frequency</td></tr>
<tr><td>Generation Type</td></tr>
<tr><td rowspan="4">Privacy</td><td>Self-only</td></tr>
<tr><td>Acquiaintance</td></tr>
<tr><td>Managers</td></tr>
<tr><td>Everyone</td></tr>
<tr><td rowspan="2">Goal Setting</td><td>Control Over Setting</td></tr>
<tr><td>Opt-out Possibility</td></tr>
<tr><td rowspan="2">Collaboration Nature</td><td>Collaborative</td></tr>
<tr><td>Competitive</td></tr>
</table>

7.3.1 Modelling Constituents and Relations

DMML divides the modelling constituents into two distinctive categories; BIS environment and its relations, and motives being added to the BIS and their connections. The final model created using DMML ties these two parts with each other by binding the relations between the motives and the constituents of the environment and enables a holistic view of the DM. The description of the two parts is as follows:

Environment

The working environment of a BIS is one of the key aspects of the engineering of motivation. It carries various types of information which are needed for engineering the process of introducing digital motivation to a BIS. From the perspective of DM, there are several constituents and their relations that shape the environment in a BIS. These constituents and the relationships are as follows:

Actors: An actor can be defined as an operating entity which tries to achieve a specific set of goals via performing certain tasks. An actor does not refer to any particular individual but positions that people can occupy to fulfil those goals through the specified tasks. Actors shape the organisational structure and define how each performer of an actor should interact with other actors. The addition of DM to a BIS may influence how people in the environment interact with each other. Hence, availability of the information regarding the actors prior to the design and implementation holds great value.

Values: Values refer to the cultural and environmental values of the BIS. The use of DM can preach various values based on its design. These values could range from encouraging competition between the workforce to collaboration. It can seek employee satisfaction or look for the highest performance possible. All these can define what the settings of proposed DM should be. Therefore, knowing the values of the environment will help in aligning the design of DM with the cultural and environmental values of the BIS.

Tasks: A task can be defined as a set of actions that help to achieve certain goals by providing instructions. Tasks are the main connection point between DM. Three aspects of a task define the setting of a motive being added to the BIS. These aspects are as follows:

The first is measurability, meaning if the outcome of the tasks can be quantified as numbers without bias. The second is uniformity, meaning whether the tasks being measured are similar in all aspects or they differ depending on the context. The last one is quality orientation, saying if the task requires intellectual effort from the employees and quality of the tasks are important or the tasks do not require a great deal of intellectual effort and are focused on quantity.

It is important to know whether the outcome of a task is measurable in numbers before assigning a motive to the task. Depending on the motive being added, information regarding the performance of an employee on a task may be used. Depending on what the motive does with the information, employees may find the measurability of the outcome a crucial factor in acceptability of the introduced motive, especially if employees are interested in what motives offer.

Next important aspect of the task a motive is being added to is whether the task is performed in a uniform manner or contextual circumstances impact the way a task is performed. The design of a motive being added to this task should be aligned with the uniformity of the task. Some settings are not compatible with non-uniform tasks and may hinder the goal of motivating employees.

Lastly, it should be known to the designer whether that task requires quality and creativity. Various settings of motives are compatible with tasks that do not rely on the intellectual effort of the employees, e.g., time pressure. Various other settings are fit for the tasks that require creativity and intellectual effort, e.g., non-competitive badges. The critical point is to assign a compatible setting to tasks. Failure in following this may result in a decrease in the quality of the outcome or demotivating the employees at the end.

Agents: Agents refer to the actual employees in the BIS who play as actors and perform the tasks to fulfil the goals. Agents are amongst the most important aspects of the BIS as their preferences on the design of the DM defines the possibility of the DM being successful. Eliciting the agents' preferences on various settings of DM is a challenging task on its own as the number of agents may be large and no one preference on the settings of the DM may be shared amongst the agents. To address this challenge the use of personas is proposed.

Personas: Personas are fictional characters that represent a group of agents which have similar preferences and requirements. The needs, preferences, and requirements of the agents a persona represents are not necessarily the same, however, they share a considerable proportion of the preferences. The personas should provide the designers with information regarding agents' preferences on five different aspects with regards to DM – incentives, performance and feedback, privacy, goal setting, and collaboration nature.

- **Incentives**

  Incentives refer to the preferences of the agents with regards to the reward they receive by means of DM. There are four characteristics of an incentive which agents may find relevant to their preferences about DM. One is whether the reward is on the quality of the outcome or the quantity. Depending on the tasks and personalities, agents may have different preferences on this aspect of an incentive. Some may find it appealing if the incentivisation is on the quality of their outcomes. Some others may argue that measurement of the quality may be challenging and biased. Therefore, they may prefer an incentivisation based on the quantity of results. Another characteristic is the availability of the incentive. Various agents may have different opinions. Some may prefer to know exactly what incentives are available for them and did not like the idea of having hidden "gems" in their working environment. Some others embraced the idea of having the element of surprise in the workplace and found it to be motivating. Next characteristic is the value of the incentive provided. This characteristic is tied with the last one that is the chance of winning. Some agents may prefer incentives high in value, even if it means a lower chance of winning the prize. They may not find low value incentives very appealing. On the other hand, some other agents may find a higher chance of winning more attractive, even though it may mean a lower value prize.

- **Performance and feedback**

  There are two aspects of the performance and feedback report that DM provides for the agents. One is the frequency of the report, and the other is the manner they were generated. DM can provide the agents with reports regarding their actual performance, e.g., points received after finishing a particular task, or feedback regarding their performance over a period. Various agents may have different opinions on what the frequency of the reports should be. With regards to the performance of the agents, some may like to have real-time reporting of their points achieved, and some may prefer longer intervals such as at the end of a day or a week. For the feedback, agents may have various opinions as some may find a lower interval encouraging and helpful, enabling them to identify their weaknesses and strengths sooner, some others may find it a source of pressure and prefer a longer interval for the feedback. In addition to the frequency of the reports, agents may have different views on how they prefer the feedback to be generated. DM uses software and can provide feedback following specific algorithms. Although some users liked this feature as a computer and algorithm cannot have a bias towards any specific agent, some agents may find this distressing as a computer cannot consider contextual situations.

- **Privacy**

  Privacy could be considered the main concern of the agents with regards to DM. DM relies on capturing information from agents, processing it, and providing the report to a specific audience. Various agents may have different views on who the audience should be and what type of information is being available to the audience. Depending on the type of information being provided, agents may differ in their preferences. Some may find it motivating to have the information available to everyone in the working environment, and some others may opt for a more conservative measure and only prefer to provide the information available to those who they find relevant. Some others may choose a more strict setting and provide the information only to their managers. In the end, some other agents may decide to provide some information only to themselves as a self-monitoring mechanism and even do not like their managers to have access to their information. This type of measure is usually taken for detailed information which agents find personal such as their detailed progress on tasks.

- **Goal setting**

  One strategy that a DM setting can follow is goal setting, that is breaking down the tasks for agents into smaller ones and provide them with the steps necessary to achieve their goals. In addition to providing the steps for the agents, goal setting can provide a progress bar towards the goal by tracking the performance of the sub-tasks, helping others plan their tasks. Agents can have different views on goal setting from two aspects. The first aspect is whether they have control over the settings, and the second aspect is whether it is a compulsory feature and they must participate.

  Some agents find having the goal setting feature helpful and useful in the environment. There could be various reasons behind this, such as being assured that the steps will result in success, or even being able to plan based on the provided progress bar. However, not every agent may find being told how to perform the tasks motivating and encouraging. Thus, providing the ability to choose and set the steps could relief these proportion of the agents, keeping the progress bar in place. This should be considered that a proportion of agents may find this feature very intrusive from both perspectives, forcing them to "work like a robot" by being told the exact steps needed for their tasks, and being monitored by means of the progress bar. Hence, providing an opting-out possibility for this proportion of agents could resolve their worries, enabling them not to use this feature when they feel the need.

- **Collaboration nature**

  Two main strategies that DM can follow are encouraging collaboration or competition amongst the agents. However, these strategies may not fit the preferences of the agents, hence fail to increase motivation or even create unwanted stress. Therefore, knowing whether agents prefer to collaborate with each other or compete, can help achieving a better design of DM.

- **Relations**

  Four types of relations can exist between constituents in a BIS environment. These relationships are described as follows

  Relations between actors and a task

  With regards to DM, if there is a relationship between some actors and a task, it is either a collaboration connection, meaning actors collaborate with each other to achieve the goal, e.g., a warehouse stock rearrangement, or a competition relation, which means actors compete to perform the task, e.g., sales.

  Relations between two tasks

  Two tasks can have a dependency relation with each other, meaning one cannot commence without the other one providing information or resources.

  Relations between a task and an actor

  Beside the perform link, there are three relationships available between a task and an actor. One is a delegation relationship which represents a delegation of a task from one actor to another. Second is the ownership relation, which describes whether an actor owns a task or not. This relation is helpful mostly when there is a delegation relation. Another relationship between a task and an actor is the genuine interest of performing a task by an actor. This case is represented when a task is delegated from an actor to another.

Relations between two actors

There are two relations between actors in a BIS from the perspective of DM, supervision and promotion. Both links try to sketch the organisational structure of the BIS. However, they have distinct usages. A supervision relation is available when an actor can supervise another actor. This allows the supervisee to have access to some work-related information that normally is not available to others in the BIS. The promotion relation tries to find the positions that actors can be promoted to. This relation can help detecting some conflicts of interest in specific cases.

Relation between agents and personas

Agents in a BIS should be mapped to the personas created in the environment. It should be considered that based on the context, e.g., for various actors, agents may choose different personas.

Relation between agents and tasks

In some cases, it matters in the BIS to know which agent is delegating which task to which agent. Therefore, mapping these relations can provide designers with useful information that can aid them in a healthier design.

Motives

A motive consists of three parts, the reward it is providing, the information it is capturing, and the persuasive technique it is employing. Each of these parts has their own characteristics and parts which are described in the following:

Table 7.3 Thematic mapping for conceptualising the motives

Motive	Reward	Policy	Competition	Individual
				Group
				None
			Collaboration	Individual
				Group
				None
			Performance	Individual
				Group
				None
		Element	Collaboration	
			Social Recognition	
			Communication	
			Accomplishment	
		Nature	Intangible	
			Tangible	
			Combined	
		Strategy	Transparency	True
				False
			Value	High
				Low
				Balanced
			Chance of Winning	High
				Low
			Points	Pre-defined
				Calculated
			Reinforcement	Positive
				Negative
				Combined
	Captured Information	Visibility	Everyone	
			Acquaintance	
			Managers	
			Self-only	
		What is Stored	personal Information	
			Work Information	Detailed
				General
			Frequency	Low
				Medium
				High
				Real-time
	Techniques	Conditioning		
		Self-monitoring		
		Surveillance		
		Tunnelling		
		Reduction		
		Tailoring		
		Suggestion		

Reward: The reward that a motive introduces to a BIS is important from four perspectives, the policy it is following, the persuasion element it is using, the nature of the reward, and strategy it is following.

- **Policy:** The policy of rewarding the motive employs could be divided into three parts. The policy can encourage competition, and/or collaboration. The competition/collaboration could be between groups or individual within a single group. It is also important to know whether the reward uses the individual performance of the agents or a collective performance of the groups.

- **Element:** The elements that rewarding can use are diverse, and each may need a different approach for the design to be aligned with the BIS. The element could be social recognition, encouraging agents to be better by providing a possibility of being known for their performance. The element could be communication, facilitating the collaboration between the agents, it could be an accomplishment, providing a feeling of achievement for the agents.

- **Nature:** The nature of the reward is a vital characteristic, and if aligned with the personality of the agents, it can help increasing the motivation and engagement. The nature of the reward could be tangible or intangible. People may find any of these types motivating based on their preferences. It is important to know the users and the rewards being introduced to an environment, then aligning the nature of the reward with the preferences of the users could prevent any incompatibility and pave the way for a more compatible DM setting for the agents in the BIS. It should be noted that a combination of both natures can be employed to satisfy agents from both preferences.

- **Strategy:** The strategy of the rewarding is a very influential factor in the design of the setting of a motive. A strategy could be transparent and available to everyone in the BIS which can help in the acceptability of the results.

However, this may not be the option for some BIS depending on the business plans they have. Another factor is the value of the reward and the chance of winning the reward. Despite the appeal of a high-value reward may have, normally the high value of a reward has a correlation with the scarcity of the reward as well. Agents may have different preferences with regards to the value and reachability of the rewards. Some agents will only be motivated if they know that they will win a prize which is high in value and do not find smaller prizes motivating and worthy of the effort. On the other hand, some other agents may argue that "certain people will always win the prize" and become demotivated since they do not see any chance of winning the prize. Therefore, they would prefer a lower value prize, but with a higher chance of winning. Another possibility is providing both high value and low-value prizes and paving the ground for both types of agents to be motivated.

- **Points:** Another aspect of a rewarding strategy that is important is the way points are given to the agents. Points could be given in a pre-defined manner, meaning that at the end of each task the agent will receive a certain amount of points. This may seem reasonable for many agents; however, another view may argue that a quality-oriented task should require a calculation of the points and the outcomes should be assessed for their quality before points are assigned. This can help keeping agents with quality-oriented tasks to perform at their higher potentials and do not do the jobs in a cursory manner.

- **Reinforcement:** The motive can have a positive reinforcement, negative reinforcement, or a combination of both. It is crucial for the analysis of the system as-is or the system-to-be to know if there exists any negative reinforcement as it can be very detrimental and drive agents to perform unethical just to avoid the negative consequences of not meeting the desired behaviour or outcome.

Captured information: DM relies on the information it captures from the environment. The agents have two concerns with regards to what DM does with their information. First one is from the visibility perspective, that is who can access the information. For some situations, agents may find it acceptable for everyone to have access to their information. Some other circumstances may arise some concerns and agents may agree for their information to be available to the relevant peers only. In some other cases, agents may opt for a more conservative measure and agree to have the information available to their managers only. There can be imagined some situations where agents only want to have the information available to themselves as a self-monitoring mechanism.

Other than the visibility of the information, agents are concerned about what is stored about them by means of DM. Since DM can facilitate sensors, actuators, software, and other digital mediums, they can be very intrusive in terms of the type of information it can capture or derive from the captured information. Therefore, agents are concerned about this information that is stored about them using DM. They are mainly concerned whether the information is personal or work related information and whether the work information is detailed or general. Agents showed concern with regards to what can be derived and inferred from the captured information, e.g., their working habits. Another aspect is the frequency of obtaining the information, that could vary from a real-time data collection to very low-frequency data collection which could be at the end of every week.

Techniques: Motives can employ *conditioning*, *self-monitoring*, *surveillance*, *tunnelling*, *reduction, tailoring* and *suggestion*, described in Chapter 2, as tools to increase motivation via DM. It is important to know how motives use these techniques as these persuasive techniques rely heavily on the perception and preferences of its users, which may be in some cases conflicting.

Conditioning: This technique may be well perceived by some users and increase their motivation, and in some others, it may create problems. As an example, when the introduced motive is using the conditioning tool, some actors may find virtual badges motivating, some others may find it useless or even stressing when it is difficult to achieve.

Self-monitoring and surveillance: These two persuasive techniques can be perceived differently by individuals. For example, some participants stated that they like to have their information available to their managers. They argued that this will enable them to enhance their image in their managers' mind as hard-working employees. However, other participants raised the issue that DM can capture and store information that is not possible to obtain otherwise, e.g., the exact time an employee was either working or idle. This was the concern of some employees, mentioning this would create a very high level of pressure on them as they would think the "big brother is watching them".

Tunnelling: Tunnelling can also be perceived differently. Some participants mentioned that they would appreciate having their tasks broken down into smaller chunks and finding it helpful in increasing their productivity. Some others stated that this would limit them and take away their freedom on how to perform their job. Hence, they found it not motivating.

Tailoring: As mentioned in Chapter 2, tailoring tries to provide employees with customised information, such as periodic feedback. Employees may find it very helpful in order to track their performance and identify areas that need more focus to be enhanced. However, the way the feedback is generated and the frequency of updating it is where employees may differ in their preferences. Failure in aligning this with the employees preferences may lead to an increase in their level of stress and mental pressure in the enterprise.

Reduction: This technique tries to make complex tasks simpler, such as automating several tasks by just one click. However, some users may argue that the use of reduction minimises the control over how they can perform the tasks, stating this will make them to “work like a robot”.

Suggestion: This tries to alert the employees about performing certain behaviours on specific times. The challenge here is to detect the current activity of employees and react accordingly, as some of the tasks that employees are performing may not be measurable or even detectable by the use of software.

7.4 Formal Specification

This section provides the mathematical definitions for the properties that are needed for modelling DM as a system-to-be or as a system-as-is:

7.4.1 Environmental Properties

Let $Ac = \{ac_1, ac_2, ac_3, \ldots, ac_n\}$ be a set of *Actors*, $P = \{p_1, p_2, p_3, \ldots, p_n\}$ be a set of identified *Personas*, $Ag = \{ag_1, ag_2.ag_3, \ldots, ag_n\}$ and $T = \{t_1, t_2, t_3, \ldots, t_n\}$ be the set of *Agents* and *Tasks* in the environment.

- **Definition 1:** Tasks

  $\forall t \in T, t =< Uniformity, Measurability, Quality - oriented|$

  $Uniformity, Measurability, Quality - oriented \in \{true, false\} >$

- **Definition 2:** Relation between *Agent* and *Persona*

  $AgP = \{agp_1, agp_2, agp_3, \ldots, agp_n\}$ is defined as a set of relations available between the agents and the personas present in the environment. Then,

  $\forall agp \in AgP, agp =< ag_i, ac_i, p_i, rel | ag_i \in Ag, ac_i \in Ac, p_i \in P, rel = Has >$

- **Definition 3:** Relation between *Agent* and *Actor*

  $AR = \{agac_1, agac_2, agac_3, \ldots, agac_n\}$ is defined as a set of relations available between agents and actors in an environment. Then,

  $\forall agac \in AgAc, agac =< ag_i, ac_i, rel | ag_i \in Ag, ac_i \in Ac, rel = Plays >$

- **Definition 4:** Relation between two *Agents*

  $AgAg = \{agag_1, agag_2, agag_3, \ldots, agag_n\}$ is defined as a set of relations available between two agents in the environment. Then,

  $\forall agag \in AgAg, agag = \{ag_i, ag_j, rel | ag_i, ag_j \in Ag, rel \subset \{Acquintaince, Close\}\}$

- **Definition 5:** Relations between two *Agents* and a *Task*

  $AgAgT = \{agagt_1, agagt_2, agagt_3, \ldots, agagt_n\}$ is defined as a set of relations available between two agents and a task in the environment. Then,

  $\forall agagt \in AgAgT, agagt =< ag_i, ag_j, t_i | ag_i, ag_j \in Ag, t_i \in T, rel = Delegated >$

- **Definition 6:** Relation between two *Actors* and a *Task*

  $AcAcT = \{acact_1, acact_2, acact_3, \ldots, acact_n\}$ is defined as a set of relations available between two actors and a task in the environment. Then,

  $\forall acact \in AcAcT, acact =< ac_i, ac_j, t_i, rel | ac_i, ac_j \in Ac, t_i \in T,$

  $rel \subset \{Competition, Collaboration\} \& rel \neq \{Competition, Collaboration\} >$

- **Definition 7:** Relation between *Persona* and *Actor*

  $PAc = \{pac_1, pac_2, pac_3, \ldots, pac_n\}$ is defined as a set of available relations between actors and present personas in the environment. Then,

  $\forall pac \in PAc, pac =< p_i, ac_i, rel | p_i \in P, ac_i \in Ac, rel \subset \{Plays, Weight\} >$

- **Definition 8:** Relations between *Actors*

  $RR = \{acac_1, acac_2, acac_3, \ldots, acac_n\}$ is defined as a set of available relations between actors in the environment. Then,

  $\forall acac \in AcAc, acac =< ac_i, ac_j, rel | ac_i, ac_j \in Ac, rel \subset \{Supervision, NextRole\} >$

- **Definition 9:** Relations between *Tasks*

  $TT = \{tt_1, tt_2, tt_3, \ldots, tt_n\}$ defined as a set of relations between tasks in the environment. Then, $\forall tt \in TT, tt =< t_i, t_j, rel | t_i, t_j \in T, rel = Dependency >$

- **Definition 10:** Relations between *Tasks* and *Actors* $TAc = \{tac_1, tac_2, tac_3, \ldots, tac_n\}$ is defined as a set of available relations between the actors and the tasks. Then, $\forall tac \in TAc, tac =< t_i, ac_i, rel | t_i \in T, ac_i \in Ac, rel \subset \{Performs, Owns, NoInterest\} >$

7.4.2 Motives

- **Definition 11:** Reward
  $RW = \{rw_1, rw_2, rw_3, \ldots, rw_n\}$ is defined as a set of rewards that motives can have. Then,
  $\forall rw \in RW, rw =< Policy, Nature, Strategy, Elements >$ where: $Policy =<$
  $type, value, performance|$
  $type \in \{competition, collaboration, combined\}, performance \in \{individual, group, both\} >$
  and
  $Nature =< type|type \in \{tangible, intangible, combined\} >$ **and**
  $Strategy =< transparency, value, chanceofwinning, points, reinforcement|transparency \in$
  $\{true, false\},$
  $value \in \{high, low, balance\}, chanceofwinning \in \{high, low, balanced\}, points \in$
  $\{pre - defined, calculated\_by = \{ac_i \in Ac\}\},$
  $reinforcement \in \{positive, negative, combined\} >$ **and** $elements =$
  $\left\{e_1^n | e \subseteq \{socialrecognition, communication, accomplishment, timepressure, \ldots\}\right\}$
- **Definition 12:** Technique
  $Te = \{te_1, te_2, te_3, \ldots, te_n\}$ is defined as the set of motivational techniques that motives in an environment can use. Then,
  $\forall te \in Te, te =< reduction, tailoring, suggestion, conditioning, self - monitoring,$
  $surveillance, tunnelling | reduction, tailoring, suggestion, conditioning, self -$
  $monitoring, surveillance, tunnelling \in \{true, false\} >$
- **Definition 13:** Captured Information
  $CI = \{ci|_1, ci_2, ci_3, \ldots, ci_i\}$ is defined as a set of possible ways that motives

can capture information. Then, $\forall ci \in CI, ci = \langle visibility, what\, is\, stored|$ $visibility \in \{everyone, relevant, managers, self-only\}$ **and** $what\, is\, stored = \langle personal\, information, frequency, work\, information|$ $personal\, information \in \{true, false\}, frequency \in \{low, medium, high\},$ $work\, information \in \{detialedinformation, generalinformation\}\rangle\rangle$

- **Definition 14:** Motives

  $M = \{m_1^n | \forall m, m =< t, rw, tl, ci >\}$ is defined as a set of motives that can be available in the environment based on the values of all constructs of each motive and the task each motive is being added to.

7.5 Meta-model

We describe the meta-model for DMML in two different parts. First we provide the meta-model for the environment that the DM is going to be introduced to, depicted in Fig. 7.1, then the meta-model for the DM itself, illustrated in Fig. 7.2.

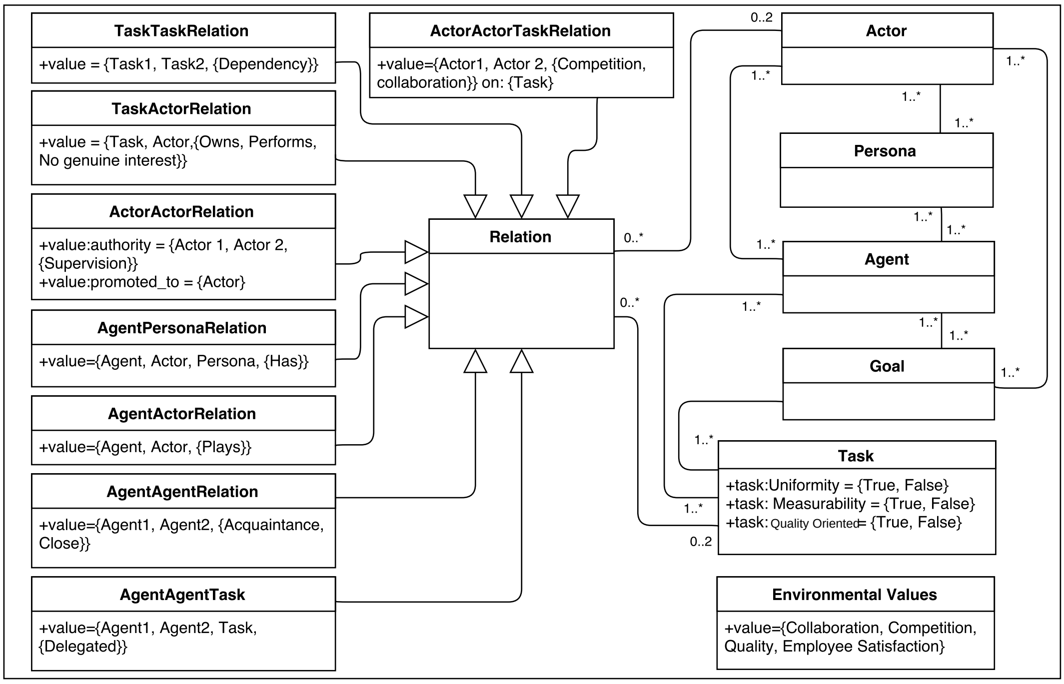


Fig. 7.1 Meta-model for the environment

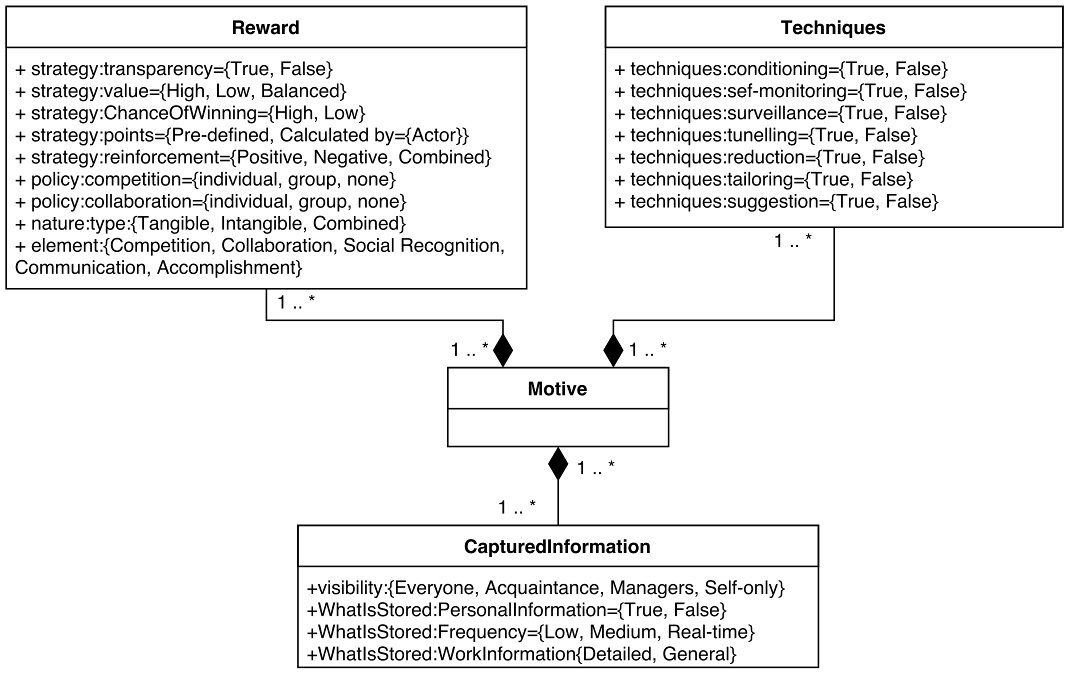


Fig. 7.2 Meta-model for the motives

7.6 Graphical Representation

This section describes each concept and constituents of DMML and elaborates on how DMML can be used to model the environment a DM design is being added to and how a motive being introduced to the BIS can be modelled and represented using DMML.

DMML builds on standard goal-oriented modelling language for various reasons. Therefore, most of the notations inherit their meanings from goal model. In the following we describe these notations in more details:

7.6.1 Modelling Parts

DMML consists of three parts. The first part describes the environment at an abstract level. The second one represents the environment, this time at the instance level, and the third one models the motives in an abstract level. The combination of these three

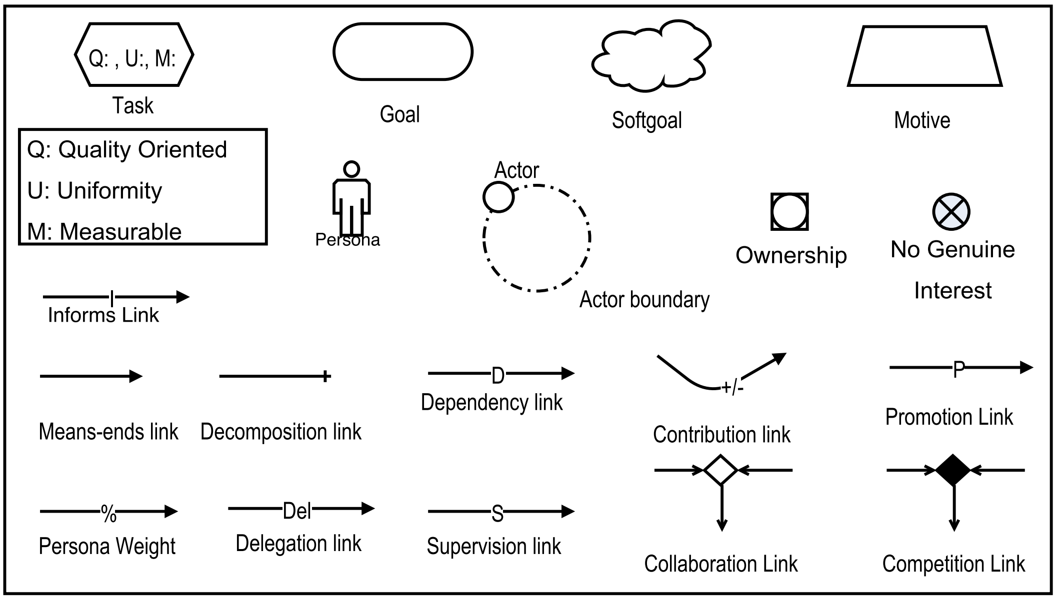


Fig. 7.3 Legend for the notation

parts can help model the whole environment and analyse the impact of DM being introduced to a BIS.

Environment – Abstract Level

An environment can be represented by nodes and links. Nodes can be the tasks, goals, soft-goals, actors, personas, and motives in the environment. Links can be a dependency, delegation, supervision, inform, promotion, ownership, No Genuine Interest, and collaboration or competition on a task/goal. These constituents are described in details in Table. 7.4.

Environment – Instance Level

In the instance level, three relations exist. First is the relationships between the actors and the actual people who perform as actors (agents). Second is the connection between personas, agents, and actors. Finally, the third one is the relation regarding agents and delegation of tasks/goals to other agents. Various agents may play an

Table 7.4 Description of DMML constituents

Nodes	Actors	Actors can be illustrated using a circle with the name of the actor inside the circle, and can have a boundary that includes their tasks, goals, and their relations
	Tasks	Tasks can be illustrated using a hexagon with the name of the task and the values for the quality oriented, measurability, and uniformity attributes inside the hexagon. The letters "Q", "M", and "U" can replace the full names to reduce the need for space
	Goals	Goals can be represented using an oval shape with the name of the goal inside the oval
	Soft-goals	Soft-goals can be represented as clouds with the name of the soft-goal inside the cloud
	Persona	Persona can be illustrated as the shape of a sticky man with the name of the persona under the sticky man.
	Motives	Motives can be represented with a trapezoid and the name of the motive inside the trapezoid.
Links	Actor Actor Task (AAT)	An AAT relation can be represented using a diamond with three arrows
		A white diamond represents a collaboration
		A black diamond represents a competition
		Actors are connected to the diamond via unidirectional arrows starting from the actors and ending in the diamond
		Task is connected to the diamond via unidirectional arrow starting from the diamond and ending in the task
		An AAT link overrides any direct relation between the actors and the task
	Dependency	The dependency relation is represented using a unidirectional arrow with the letter "D" in the middle of the arrow
		The direction of the arrow starts from dependers towards the dependees
	Delegation	The delegation relation is represented using a unidirectional arrow with the term "Del" in the middle of the arrow
		The direction of the arrow starts from the task/goal being delegated to the actor as the delegatee
	Informs	The inform relation is represented as an arrow from the informer node towards the information receiver
		The inform link can be bidirectional in case both nodes provide information for each other
	Promotes	The promote relation is represented as a unidirectional arrow with the letter "P" in the middle of the arrow
		The arrow starts from an actor lower in the organisational structure hierarchy and ends in another actor one level higher in the organisational structure hierarchy
	Ownership	Ownership can be represented by a badge as a box with a circle inside it attached to tasks/goals
		When the ownership badge is attached to a task/goal, it emphasises that the owner of the task/goal is the actor who has this badge in the boundary
		This badge becomes useful in case of task/goal delegations
	No Genuine Interest	The NGI can be illustrated using a badge as a circle with a cross sign inside it attached to tasks/goals
		When the NGI badge is attached to a task/goal, it emphasises that the actor who has this badge in the boundary is not interested in performing the task or achieving the goals
		This badge becomes useful in case of task/goal delegations
	Persona Weight	The weight of a persona for an actor can be represented via an arrow with the weight of the persona in percentages in the middle of the arrow
		The arrow starts from the persona and ends in the actor

Table 7.5 Actor-agent mapping

Actor	**Agent**

Table 7.6 Persona-agent-actor mapping

Persona	**Agent**	**Actor**

Table 7.7 Task-delegation mapping

Agent	**Delegated Task/Goal**	**Delegated From**	**Genuine Interest**

actor, and an agent may act as different actors in the environment. For ease of interpretation, we use a table, see Table. 7.5, to map the actors and the actual people.

The next relation is the link between personas, actors, and agents, representing available personas in the environment and the agents who assign themselves to the given personas based on each Actor separately. Since players may choose different personalities depending on the role they have in the environment, it provides more information if the persona for the players is represented by the actor they are playing. See Table. 7.6 as a reference.

The next link is the relations regarding the delegation of tasks at an instance level. For this purpose, we need to put together and map the name of the agent that the task is being delegated to, the task being delegated, the agent that the task is being delegated from, and, if the delegatee has a genuine interest in performing the task. Table. 7.7 can be used for this purpose.

Motives – Abstract Level

To model the motives being introduced to the environment, the meta-model provided should be used to facilitate the relevant information for each motive to shape its settings. This research uses a UML-like static structure diagram to describe motives. A general setting for each motive can be defined from the set of possible attributes that a motive can have. Each instance then can inherit the settings and have its own values for those attributes. Various instances of a class, e.g., leader-board, may be created with different values for the attributes. The instances of the motives will be used in the abstract level modelling of the environment. Since the abstract level of motives can carry a lot of information, their abstract modelling is separated, and the instance of it in the modelling of the environment is provided.

7.7 Motivation Requirements Analysis

Facilitating the DMML can provide BISs with viable solutions for addressing difficulties that may emerge because of introducing a DM to the system. This is possible since DMML enables an automated motivation requirements analysis and software tool support. Facilitating an automated analysis via algorithmic investigation enables identifying problems and flaws in the design of DM such as conflict of interest or sabotage. This section provides a running example which allows the use of DMML in performing automated analysis to identify and detect these design flaws. The example represents an IT department of a University, derived from publicly available documents, organisational structure and hierarchy of the university, and job descriptions related to the roles in the IT department. The motives added to the IT department do not represent the actual system and are added to the model for descriptive purposes.

7.7.1 Running Example

To present the abilities of DMML, a running example is provided. This example represents an IT department of a University. To simplify the example, only four of the jobs in the IT department are considered: help desk support analyst; help desk support supervisor; user support analyst; user support supervisor. The following explains the description of the responsibilities of each job.

Help Desk Support Analyst

A help desk support analyst's main duty is to resolve the incidents which are reported to the IT department via its website, email, or phone calls. They are required to maintain the records of the incidents and log the person responsible for solving the issues. Also, a help desk support analyst is expected to inform the users about the progress on the incidents via frequent updates and timely reports. They are required to assess the incident and decide whether to solve the problem using administrative rights, remote desktop tools, or diagnostic tools or to escalate the problem to a higher level. Following the guidelines, they will decide whether to escalate the incident to the help desk support supervisor or, to the user support analysts. In either case, a help desk support analyst is responsible for the task and needs to follow up the state of the progress and inform the users. To keep the users' satisfaction at an acceptable level, it is expected from the help desk support analysts to stay up to date with the knowledge, participate in training sessions, read the policies regularly, and keep calm while dealing with the users.

Help Desk Support Supervisor

A help desk support supervisor's main duty is to ensure that the help desk support analysts are performing well, they are provided with the necessary resources, and to resolve the escalated incidents by either delegating to the user support team or providing second line support. The second line support can be delivered through direct communication with the user, using remote desktop tools, diagnostic tools, or administrative rights. To ensure the integrity of the system as a whole, the help desk support supervisor is expected to escalate any issue that is diagnosed through escalating to the correct team. To make sure that the help desk support analysts are performing well, the supervisor is expected to monitor the progress and state of the incidents via records created by the help desk support analysts. The supervisor is also responsible for keeping the help desk support analyst team resourceful and updated. This is usually achieved by recruiting new staff if required, providing training sessions, and communicating updated policies with the team.

User support analyst

A user support analyst is required to make sure that the computer system of the organisation performs properly. As part of their daily responsibilities, they need to ensure the integrity and security of the system. Once a security incident is reported, they will need to give it a high priority and react to it quickly. In case the issue is major and needs escalation to a higher team, they need to report it and escalate the incident promptly. Also, they are responsible for keeping the documents and the policies up to date by regular reviewing. Participating in training sessions is also necessary to help to keep the knowledge up to date. In addition to keeping their knowledge up to date, they are responsible for disseminating the policies and documents to other teams. Lastly, the user support analyst team is expected to provide first line support on a rota basis. This is mainly with regards to the issues that the help desk support analysts cannot handle, but hold minor importance and do not require escalation to a higher level.

User support supervisor

A user support supervisor is responsible for making sure that the support analysts are performing well and needs to liaise with other teams to ensure the integrity of the computer system and delegate tasks when necessary. One major responsibility of the support team is to implement and integrate projects to the current computer system which requires liaising with other managers, allocating tasks to team members, and forwarding appropriate tasks to other teams. Also, to ensure the acceptable performance of the team, the supervisor is expected to communicate policies and documents with the team members, recruit new staff when required, and provide training sessions for the staff. To keep the integrity of the system in place, the supervisor requires responding to incidents escalated from the team and delegate to the appropriate team or department. Lastly, the user support supervisor works closely with the help desk support supervisor and allocates some first line support tasks to the team members on a rota basis. These incidents are mainly the responsibility of the help desk support analysts in which they are not capable of solving.

Adding digital motivation

The management team of the University realised that the IT department lacks motivation in their work and user satisfaction is reduced. To tackle this issue, it has been decided to add DM to the current system with the aim of increasing employees' engagement and motivation.

As a result, it was decided to provide a leader-board for the main task of the IT department, that is resolving incidents and issues raised by the users. The leader-board is visible to all employees, and the points are given to the individual employees if they solve the issue with feedback from the users as satisfactory. At the end of each month, a £25 voucher will be awarded to the person at the top of the leader-board. Since the employees receive calls and incidents on a rota basis, all employees will receive a fair share of users to solve their issues, and the chance of winning is equal for all. In addition to the leader-board, the employees who receive high satisfactory points from the users receive different tiers of the *solver* badge. The badges can be given to anyone who meets the criteria and is not limited. The badges are visible to all employees, which can showcase the capabilities of individuals.

The management also decided to add a progress bar to the responsibility of informing the users. This progress bar can help the managers and employees to keep track of the current situation of this responsibility and act accordingly. The progress bar is designed at the team level, meaning that it represents the progress of the team and remaining tasks for the team as a whole. All individuals can see the progress bar and help the team to make progress when they can. The managerial team is hoping to create a collaborative culture by implementing this progress bar. The information provided by this motive can help the supervisors to monitor the performance of the team.

To encourage the employees to keep their knowledge up to date and benefit from the training sessions, the managers added a leader-board for both training sessions dedicated for help desk support analysts and user support analysts. The leader-board showcases the top performers in the training sessions and uses the tests in the training as a mean to decide who the top performers are.

To keep track of the progress of the projects dedicated to the user support analyst team, a progress bar is added to the tasks. The progress bar helps the managers and the employees to keep track of the progress and make decisions when necessary. The progress bar is at a team level, and only the supervisors and the team members have access to this progress bar.

A progress bar is also added to the *review documentation* task to provide a source of information with regards to which documents require reviewing and what the status of the progress is. Since the task is highly qualitative, the information provider is the employee, and it is used as a form of information tracker and provider for the supervisors and the employees. However, the managers will provide a badge for the active *knowledge updaters* according to their efforts. The badges will have tiers and levels, representing the effort required to achieve each.

7.7.2 Conflict of Interest

The conflict of interest is when an agent has the possibility of hindering something in the environment to gain advantages over other agents. It can happen when there

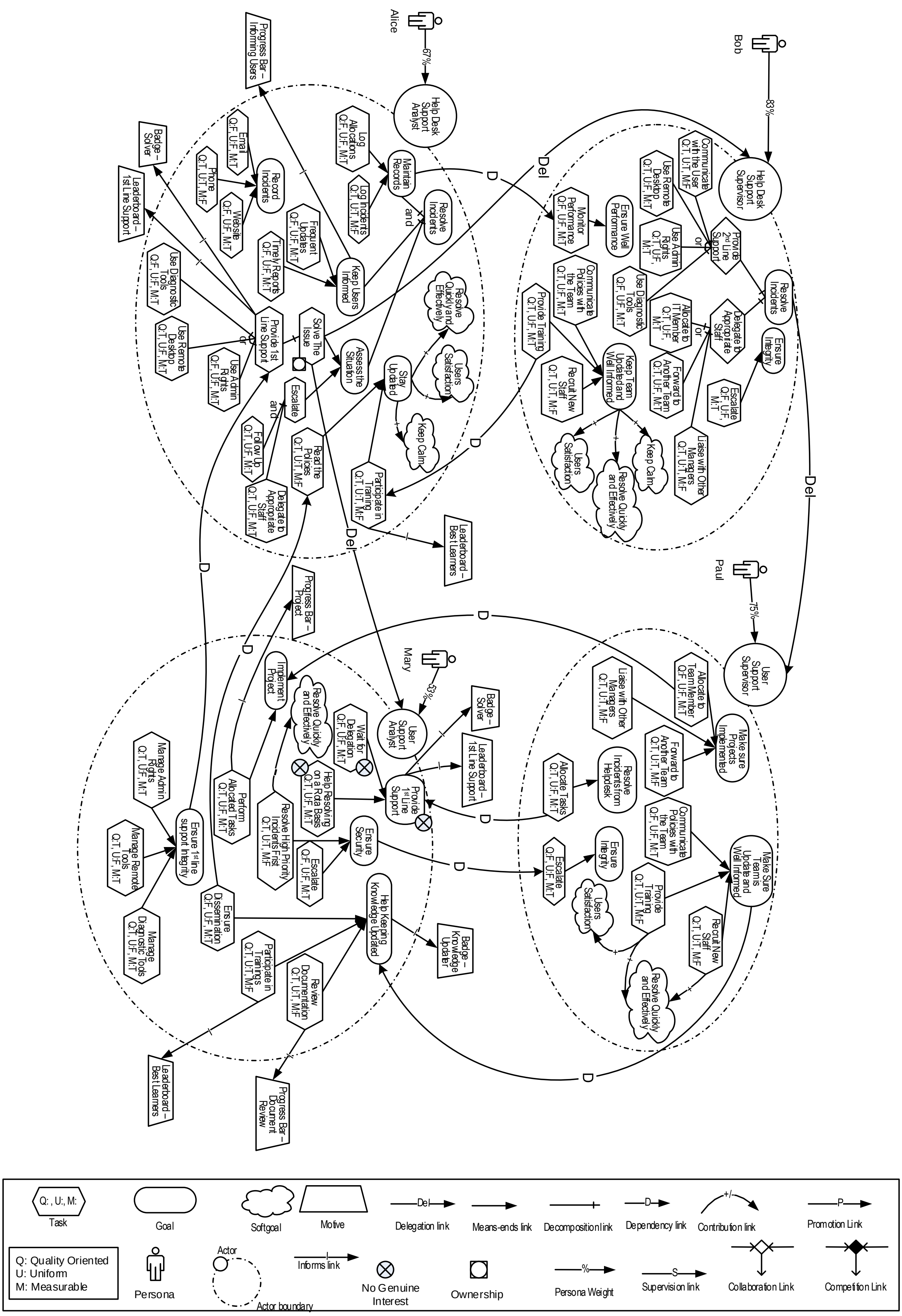


Fig. 7.4 DMML for IT Department

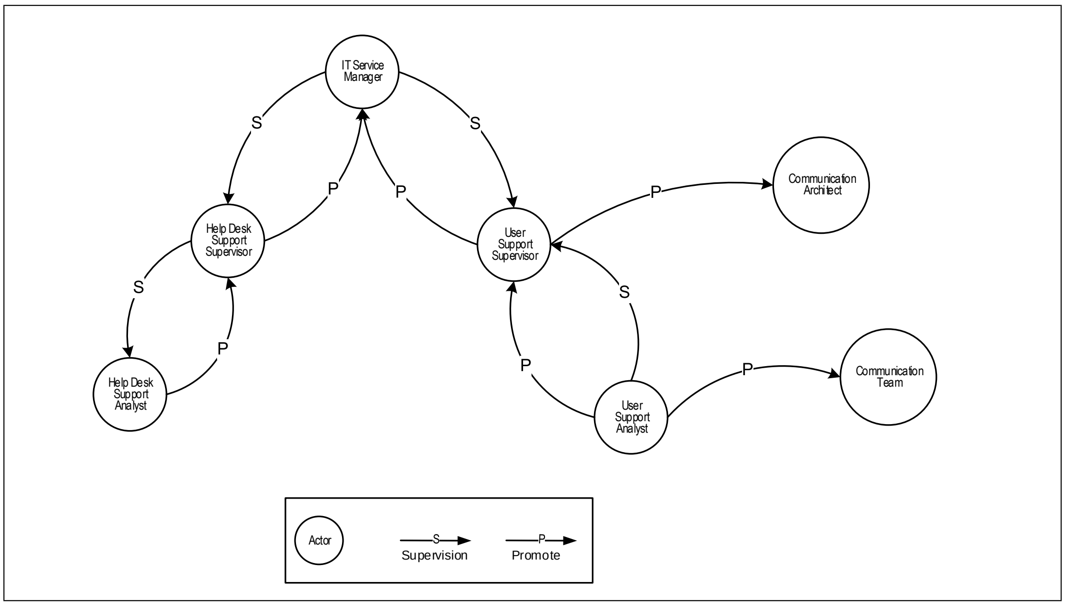


Fig. 7.5 DMML for actors' relation

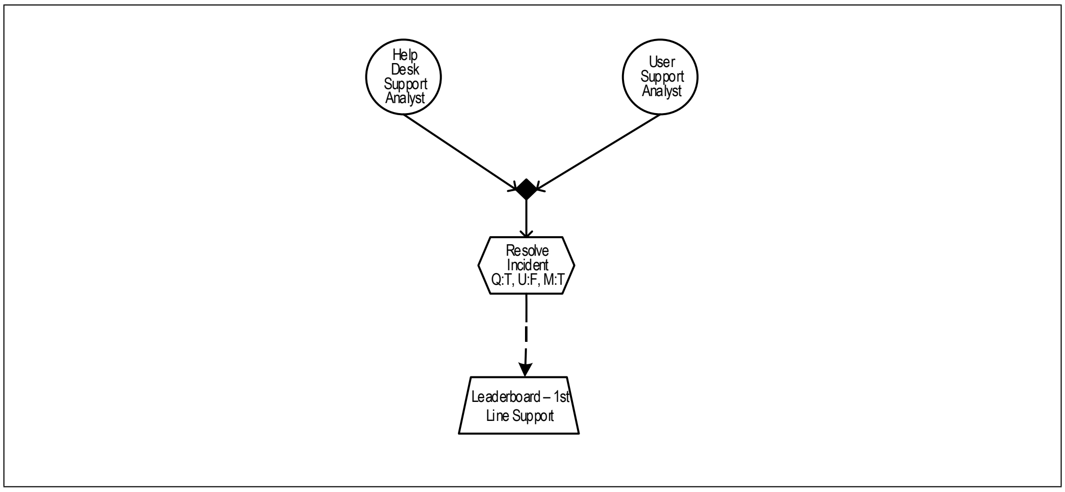


Fig. 7.6 DMML for actors' relation on a task

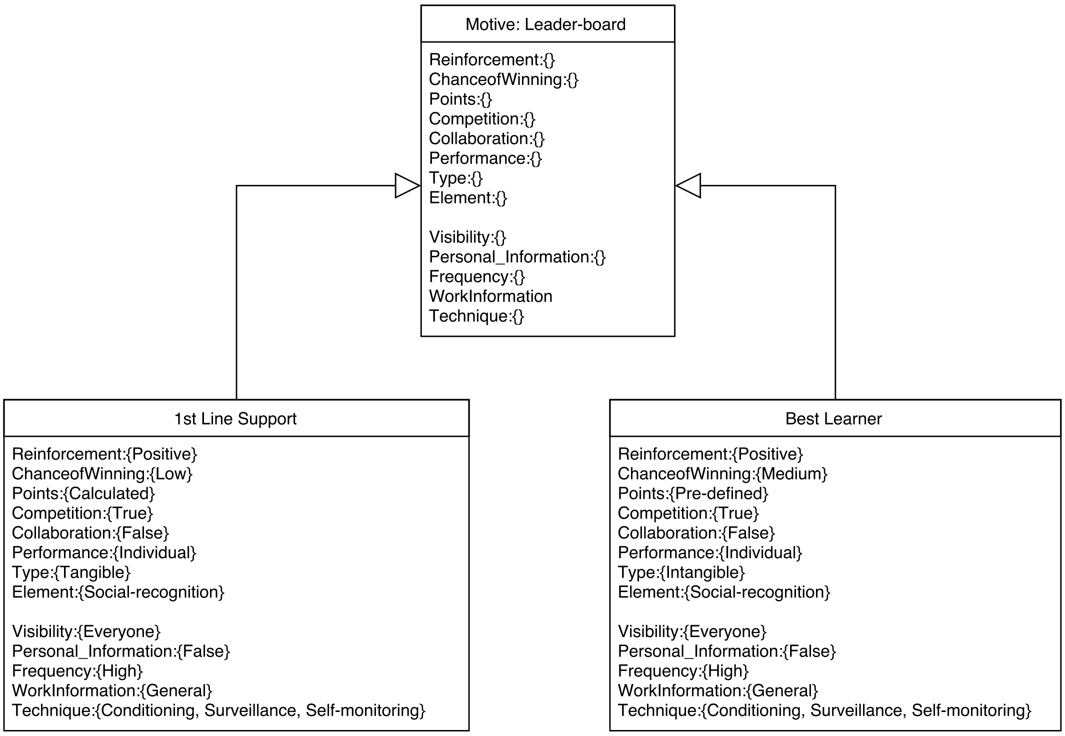


Fig. 7.7 DMML for motives – leaderboards

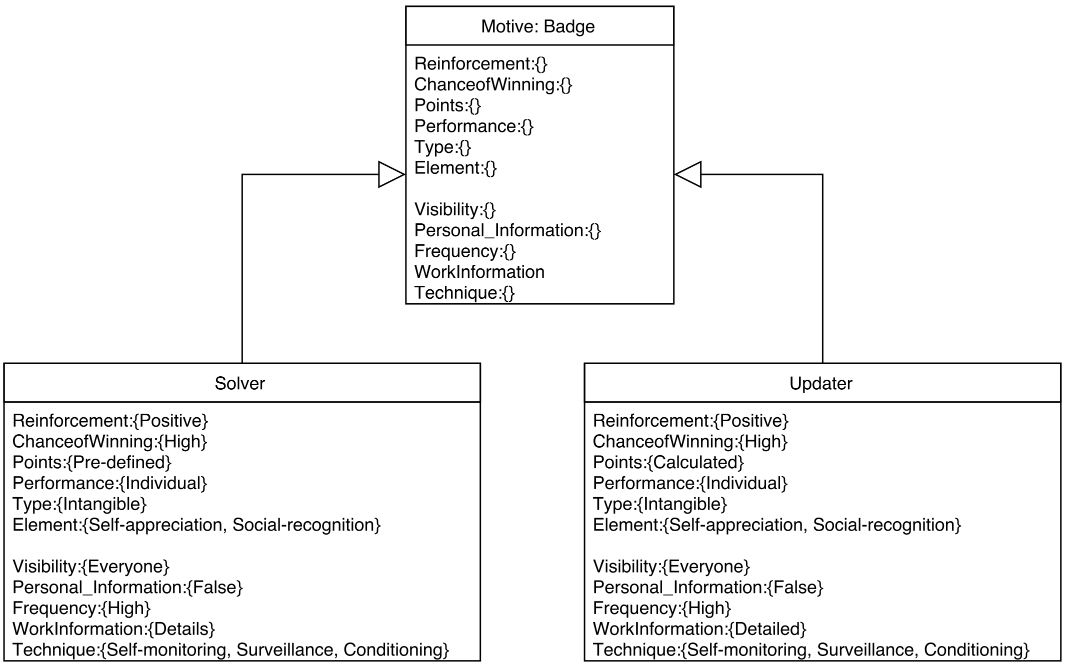


Fig. 7.8 DMML for motives – badges

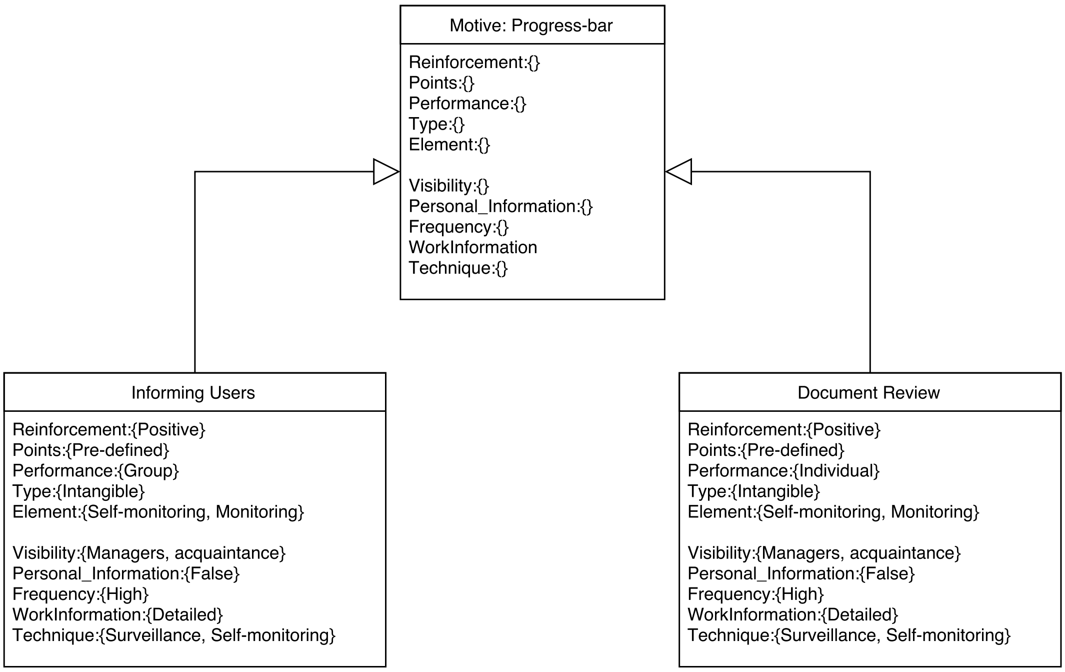


Fig. 7.9 DMML for motives – progress-bars

Table 7.8 Mapping of actors with the agents

Actor	Agent
Help Desk Support Supervisor	Kevin
	Joseph
	Angella
User Support Supervisor	Joshua
	Chris
	Alex
Help Desk Support Analyst	Andrew
	Kieran
	Katie
	Conor
User Support Analyst	Conor
	Joe
	Benjamin
	Jacob

is a competition introduced by the settings of DM on a certain task/goal, and there is a dependency relation between this task/goal and another task/goal. If one agent from the competition can interfere with the dependee task, he/she can cause a disturbance in other agents' performance and gain benefit from this. A healthy design of DM should be able to detect such conflict of interest and resolve this issue before introducing the DM to the BIS.

Description

Focusing on the help desk support analyst team and the user support analyst team, depicted in Fig. 7.10 in the running example, two teams of user support analysts and help desk support analysts are set to compete on the task *provide 1st line support*, as illustrated in Fig. 7.6. The competition is introduced using a leader-board with a low chance of winning, human calculated points, focusing on the individual performance of the users, providing a high-value reward, that is represented using the meta-model provided in Fig. 7.7. As depicted in Fig. 7.4, it is also noticeable that there is a dependency link between the *ensure 1st line support integrity* of the user support analyst team and the *resolve incident* task.

There are few problems in this situation which are discussed. A leader-board is not compatible with the collaborative environmental value of the organisation. The university wants all staff to collaborate with each other and help to achieve the final goals. However, a leader-board is competitive in nature which is not compatible with the environmental values of the environment. Moreover, there is a risk of conflict of interest as there exists a dependency link between the *resolve incident* task and *ensuring 1st line support integrity*. The problem is raised when an actor in the competition has control over the integrity of the work of another actor. The conflict of interest is more aggravated as there is no control over the performance of user support team on *ensuring integrity* goal, allowing them to hinder the task with minimum risk of getting caught. Algorithm 1 tries to address the detection of conflict of interest.

Algorithm 1: Conflict of Interest Detection

Input : $A : \{a \mid a\, is\, an\, actor\}, T : \{t \mid t\, is\, a\, task\}, R : \{r \mid r\, is\, a\, relation\},$
$M : \{m \mid m\, is\, a\, motive\}, AG : \{ag \mid ag\, is\, an\, agent\}$

Output : Possibility of "Conflict of Interest"

foreach $t \in T$ **do**
    foreach $m \in M$ **do**
        if $((t \subset m)\&\&(\text{"}competition\text{"} \subset m))$ **then**
            competitive_tasks [ ] +=t
        end
    end
end
foreach $t \in competitive\_tasks$ **do**
    if *t.Check_for_dependency()==True* **then**
        if $((\exists(ag \in AG|t \subset ag))\ \&\&\ (\exists(t.dependee \subset ag))$
        $\&\&$
        $(\exists(ag \in AG|t \subset ag))\ \&\&\ \exists(t.dependee \not\subset ag)))$ **then**
            RETURN "Risk of Conflict of Interest"
        end
    end
end

7.7.3 Bribe for an Exchange

Bribe for an exchange can happen when an agent can allow another agent to win when asking for a favour or ask another agent to let him/her win when being asked to do a favour. Bribe for an exchange can be very unpleasant from a business point of view as in the case of quality oriented tasks; this may reduce the quality since an agent may be assured of the win as a bribe. This is more likely to happen when there is a competition in place, there is a high-value reward involved, and a delegation of a task which is out of the scope of the reward is happening. A healthy design of DM should be able to detect the happening likelihood of this issue and introduce preventive measures.

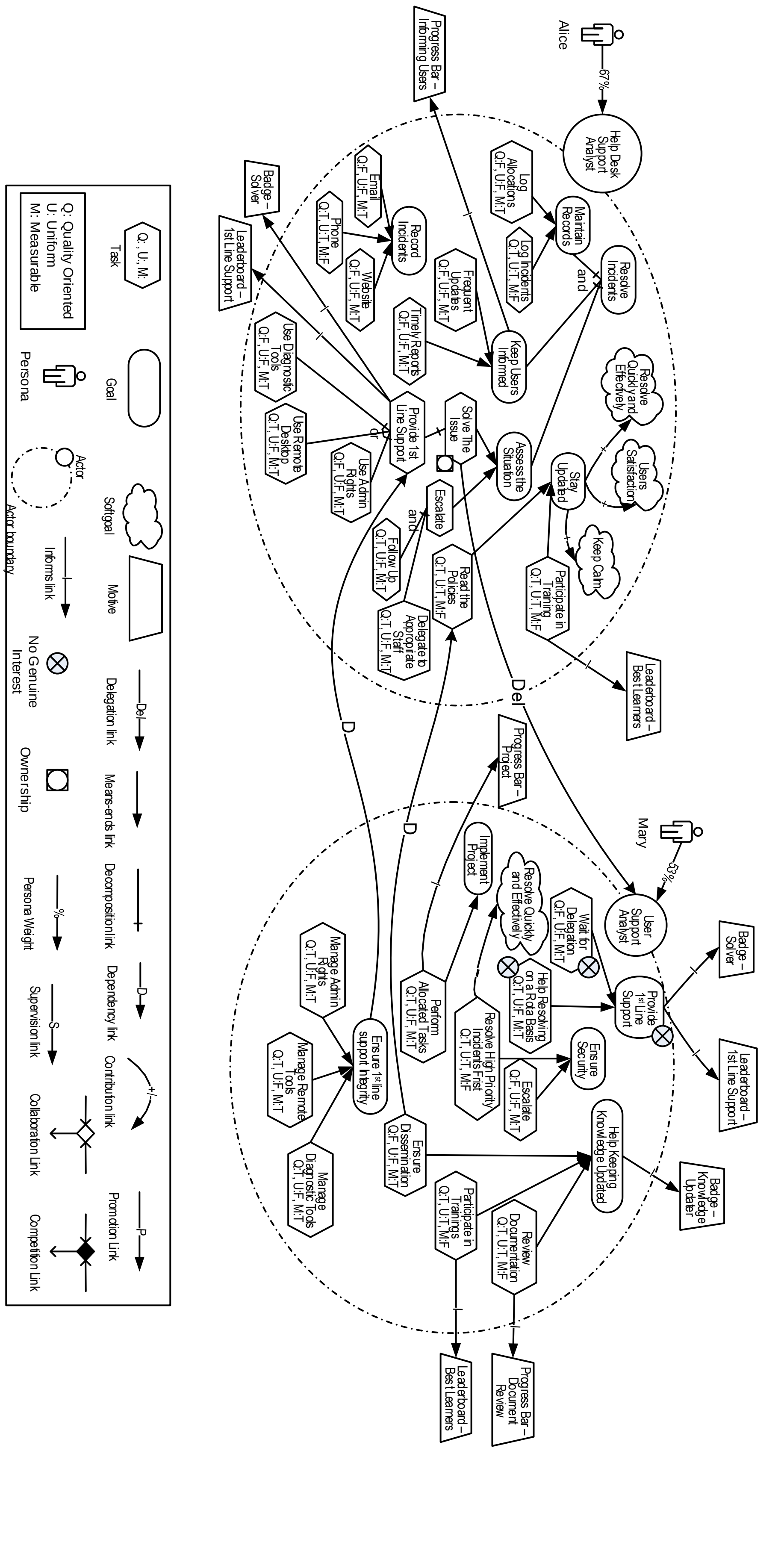


Fig. 7.10 Running example – conflict of interest

Table 7.9 DMML task delegation mapping

Agent	Delegated Task/Goal	From	Genuine Interest
Kieran	Maintain Records	Conor	No

Description

In the running example depicted in Fig. 7.11, a leader-board is added to the training sessions to increase the motivation of the staff in participating in the learning activities. Training sessions take place on a regular basis and give the winners of the leader-board social recognition. On the other hand, the user support analyst team needs to make sure that the knowledge is up to date. As illustrated in Table. 7.8, Conor has responsibilities in both teams. Conor is behind his tasks in reviewing the documentations and asks his supervisor Kevin to delegate his share of responsibility in *maintaining records* to another employee in the help desk support team. Kevin agrees to this with the condition of an employee voluntarily accepting to cover for Conor. The mapping of the task delegation and the agents involved in this is presented in Table. 7.9 in case *Kieran* agrees to cover for Conor.

This scenario may seem reasonable at first glance; however, there is a risk hidden in the setting. Since there is a competition in the learning sessions for the leader-board (see Fig. 7.7), Conor may offer to let a team member win if he/she agrees to cover for Conor. Also, there is a risk of the team member asking for the same from Conor. In either case, the team member has an increased chance of winning in the leader-board and may reduce the expected effort. This situation may result in a decrease in the quality of learning which is undesirable from the perspective of the management. Algorithm 2 enables the detection of bribe for an exchange.

7.7.4 Free-riding

Free-riding is when a group member performs less than the required share as he/she perceives that other members will do the job. Free-riding can increase the tension in

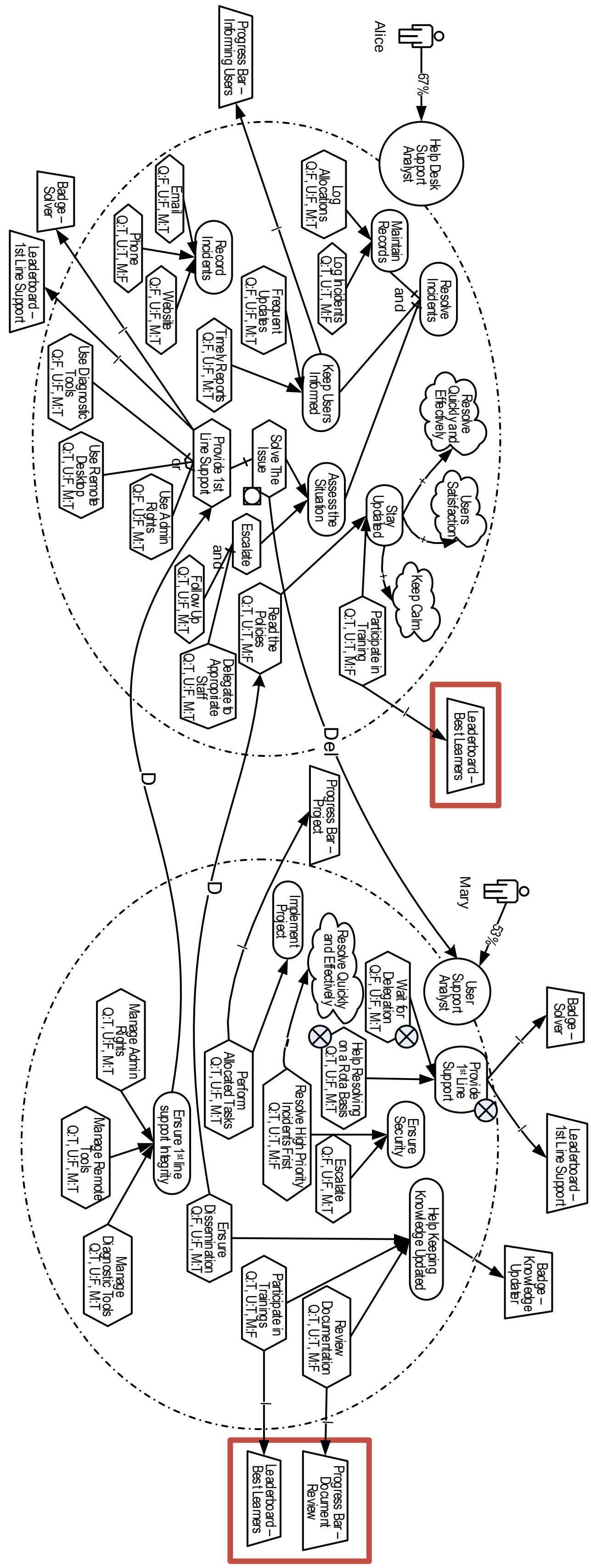


Fig. 7.11 Running example – bribe for an exchange

Algorithm 2: Bribe for an Exchange Detection

Input : $A : \{a \mid a\, is\, an\, actor\}$, $T : \{t \mid t\, is\, a\, task\}$, $R : \{r \mid r\, is\, a\, relation\}$, $M : \{m \mid m\, is\, a\, motive\}$, $AG : \{ag \mid ag\, is\, an\, agent\}$

Output : Possibility of "Bribe for an Exchange"

foreach $r \in R$ **do**
  if "$Delegate$" $\in r$ **then**
    Agents[ ] = r.extract(ag)
  end
end
if $(\exists(m \in M \mid$ "$competition$" $\in m))$ **then**
  Tasks[]=m.extract(t)
end
foreach $t \in$ *Tasks[]* **do**
  if $(Agents \subset t.extract(ag))$ **then**
    RETURN "There is a risk of Bribe for an Exchange"
  end
end

group activities and decrease the performance of the group. It is likely to happen when there is a group activity, and personal contributions are not captured via DM. In addition, it is more likely to happen if an individual agent has no genuine interest in the goal to be fulfilled. Such as a case where an agent has a delegated task from another group which he/she will not benefit from the gained rewards.

Description

In the running example depicted in Fig. 7.12, a progress-bar is added to the task *keep users informed*. The progress bar is available to the supervisor and the team members, allowing them to track the current state of the performance with regards to this task. To encourage collaboration, the progress-bar collects the performance of the group and does not rely on the individual performance of the employees involved in this task. Andrew from the help desk support analyst team calls sick and is not able to be present for work. Since this goal has a direct impact on users' satisfaction, the managers delegate the task to Joe from user support analyst team to cover for Andrew.

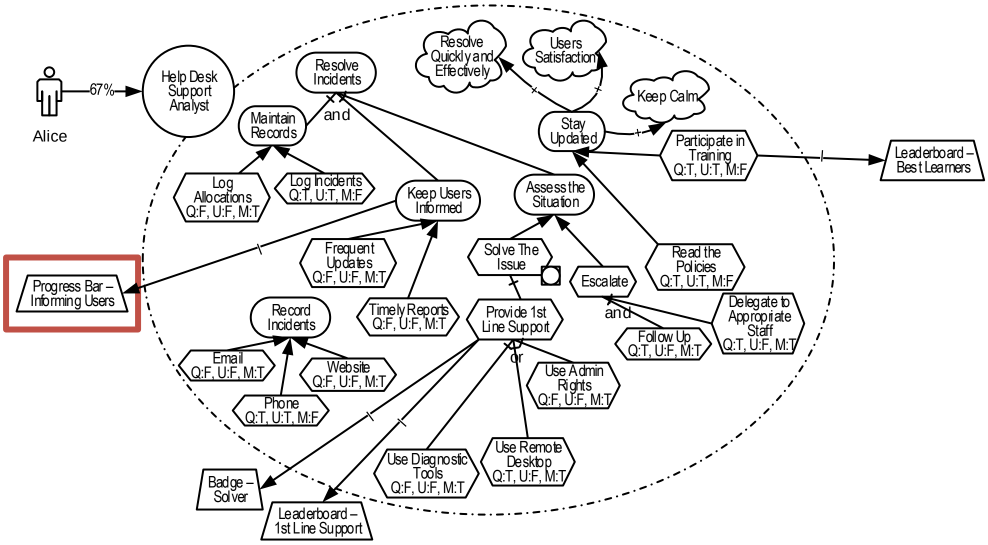


Fig. 7.12 Running example – free riding

Table 7.10 Task delegation to agents mapping

Agent	Delegated Task/Goal	From	Genuine Interest
Joe	Keep Users Informed	Andrew	No

Although the settings in this scenario may seem fine, the problem arises when Joe from the user support analyst is assigned to the help desk support team to cover for Andrew. Since the monitoring system for the progress bar merely relies on the group performance of the employees involved in the task and individual contributions are not acknowledged, Joe from the user support analyst team may put minimum efforts and rely on the fact that the other team members will do the task at te end. Algorithm 3 provides the detection of free riding. Table. 7.10 illustrates the mapping between the agents involved in this situation.

7.7.5 Secrecy

Secrecy is when agents find a solution which can aid in achieving the business goals with a higher quality or performance. However, decide to keep it as a secret of their group since it provides them with benefits. This is likely to happen in cases where groups or agents are competing for high-value prizes, and the sharing of

Algorithm 3: Free Riding Detection

Input : $A : \{a \mid a\, is\, an\, actor\}$, $T : \{t \mid t\, is\, a\, task\}$, $R : \{r \mid r\, is\, a\, relation\}$, $M : \{m \mid m\, is\, a\, motive\}$, $AG : \{ag \mid ag\, is\, an\, agent\}$

Output : Possibility of “Free riding”

```
foreach m ∈ M do
    if m.reward_policy.performance==“group”
    &&
    m.reward_policy.competition == True then
        Task=m.extract(t) if (∃(r ∈ R|“delegate” ∈ r&&Task ∈ r)) then
            RETURN “There is a risk for Free Riding”
        end
    end
end
```

information has lower value or even no value. This will prevent all the other agents and groups from using the found solution and will prevent the organisation from higher performance or quality. A design of DM should be able to detect and prevent secrecy from happening.

Description

In the running example illustrated in Fig. 7.13, the user support analyst team and help desk support analyst team are set to compete on the *1st line support* task. This is a critical task in the environment, and it has a direct impact on the users' satisfaction. Hence, all teams in the IT department are involved in this task. The organisation values collaboration and sharing of information within teams, which can lead to resolving the issues in a higher quality and less time. It is in the interest of the organisation for its employees to be active in finding innovative and novel solutions to issues users may have in the environment and sharing them with other teams and members.

Further analysis on the current setting of DM in the given environment shows that there is a risk of secrecy in the environment. The reason for this risk is the incompatibility of having a competitive element, very high-value reward, and the expectation of collaboration and information sharing. Teams may find frameworks or solutions that can help resolve issues more efficiently, but they may opt to keep them like a secret to themselves to increase their chance of winning the rewards. Algorithm 4 detects the possibility of secrecy to happen in a BIS.

Algorithm 4: Secrecy Detection

Input : $A : \{a \mid a\, is\, an\, actor\}$, $T : \{t \mid t\, is\, a\, task\}$, $R : \{r \mid r\, is\, a\, relation\}$, $M : \{m \mid m\, is\, a\, motive\}$, $AG : \{ag \mid ag\, is\, an\, agent\}$

Output : Possibility of "Secrecy"

if *environment.value == "Collaboration"* **then**
    if $(\exists(m \in M | m.reward\_strategy.element ==$ "$Competition$")) && ($m.reward\_strategy.value ==$ "$High$") **then**
        RETURN "There is a risk of secrecy
    end
end

7.7.6 Workplace Intimidation

Several circumstances can lead to workplace intimidation and bullying. An example of workplace intimidation is when agents with higher performance group together and put pressure on agents with lower performance. The likelihood of workplace intimidation increases when the agents are compared with each other, or they have access to each other's performance, weaknesses, or strengths. A healthy design of DM should consider the probability of happening of work intimidation and provide preventive measures.

Description

In the running example, a *solver* badge is given to employees who solve the issues of the users effectively. To keep the badges diverse and sustain their attractiveness for the employees, badges are given to specific skills employees hold and have tiers which showscases the amount of expertise. This can also allow managers to

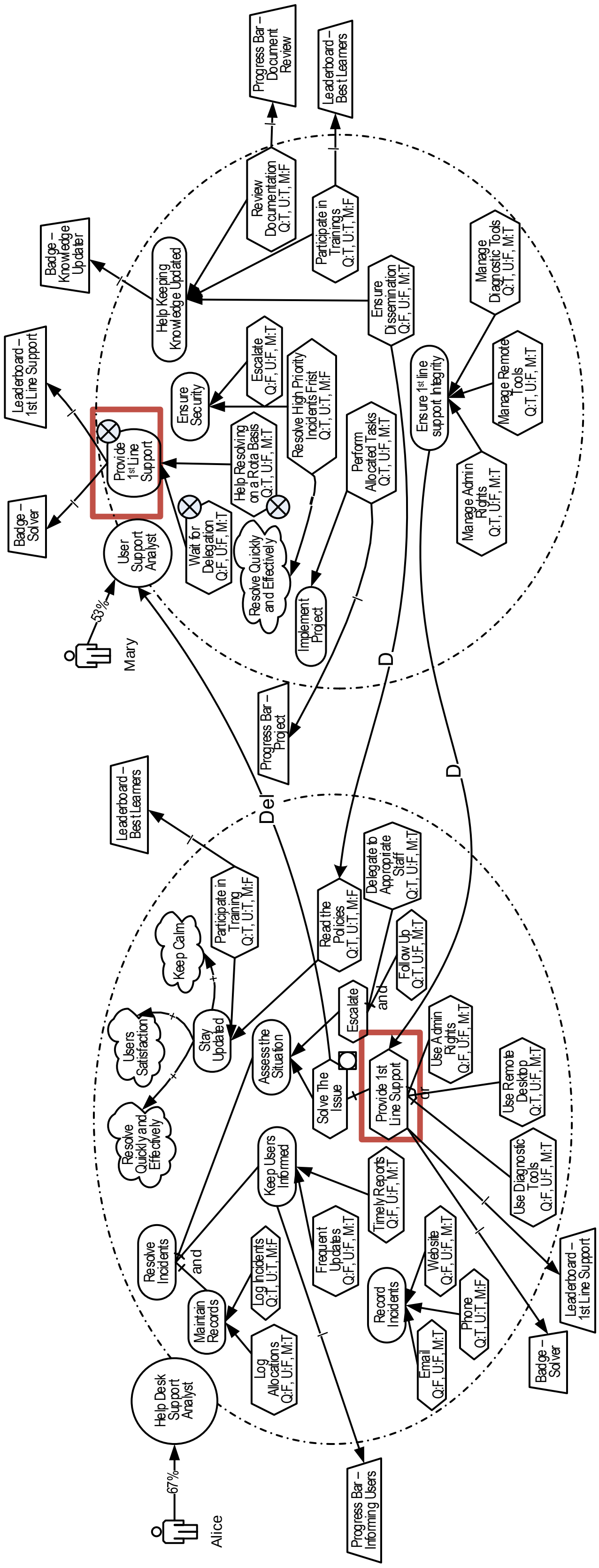


Fig. 7.13 Running example – secrecy

understand strengths of employees and assign tasks to them that is relevant to them and suits their level of expertise.

Algorithm 5: Workplace Intimidation Detection

Input : $A : \{a \mid a\,is\,an\,actor\}$, $T : \{t \mid t\,is\,a\,task\}$, $R : \{r \mid r\,is\,a\,relation\}$, $M : \{m \mid m\,is\,a\,motive\}$, $AG : \{ag \mid ag\,is\,an\,agent\}$

Output : Possibility of "Workplace Intimidation"

```
if (environment.value==“Collaboration”) then
    foreach m ∈ M do
        if ((m.rewarding_policy.performance ==“Individual”) &&
         (m.captured_information_workrelated==“detailed”) &&
        (m.captured_information_visibility == “relevant peers”)) then
            RETURN “There is a risk of workplace intimidation”
        end
    end
end
```

7.8 Requirements-Driven Architecture for Motivation

Motivation is highly reliant on personal preferences of the staff it is being applied. Therefore, it is beneficial to employ a user-centred design process for DM to elicit users' requirements and preferences on DM to ensure a more acceptable design from the perspective of users. Various aspects, e.g., contextual changes or a motive becoming annoying over the course of time, may lead to a change in what employees find motivating. The dynamic nature of motivation demands an evolve-able approach to empower detecting the need for evolution and alter the DM system according to the new requirements and preferences. In the light of the findings, this chapter sketches a blueprint for a conceptual architecture that facilitates a systematic evolve-able user-centred design of DM, depicted in Fig. 7.15.

Initially, this chapter advocates the creation of personas, based on necessary persona constituents provided in Chapter 6. The identified personas can inform the DM design with the requirements and preferences of each persona. The provided

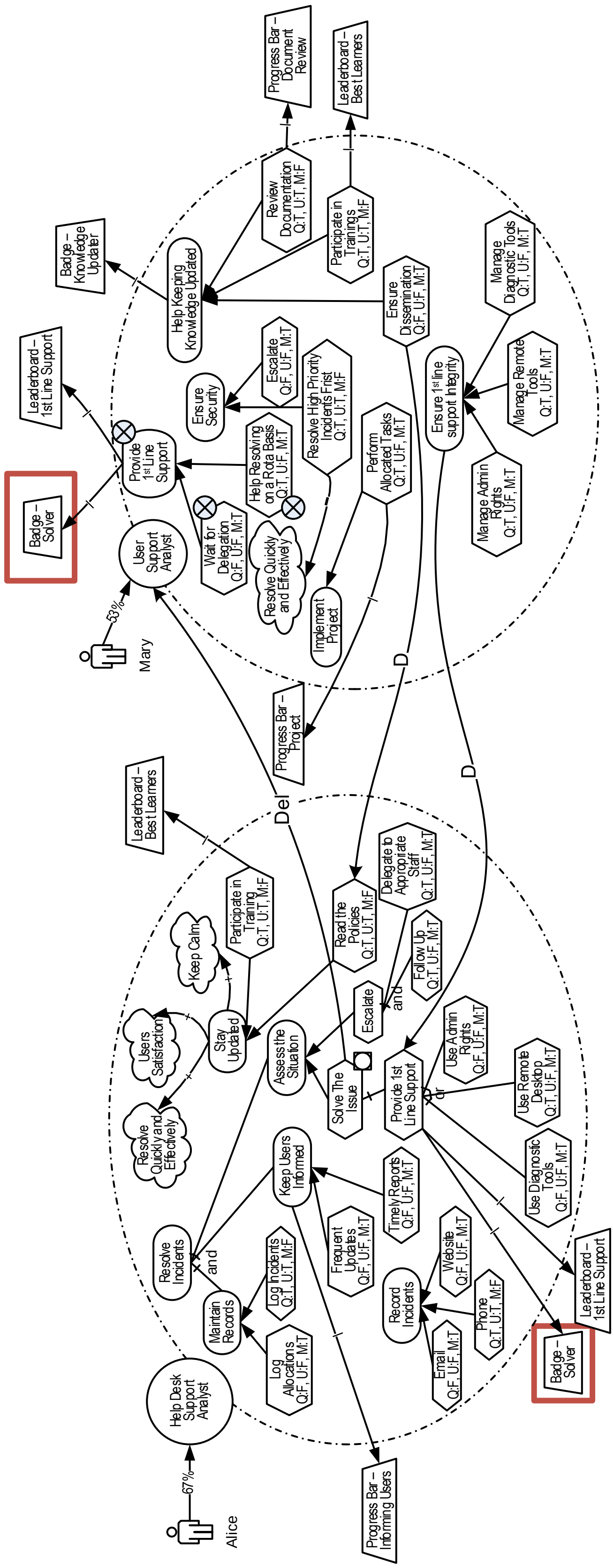


Fig. 7.14 Running example – workplace intimidation

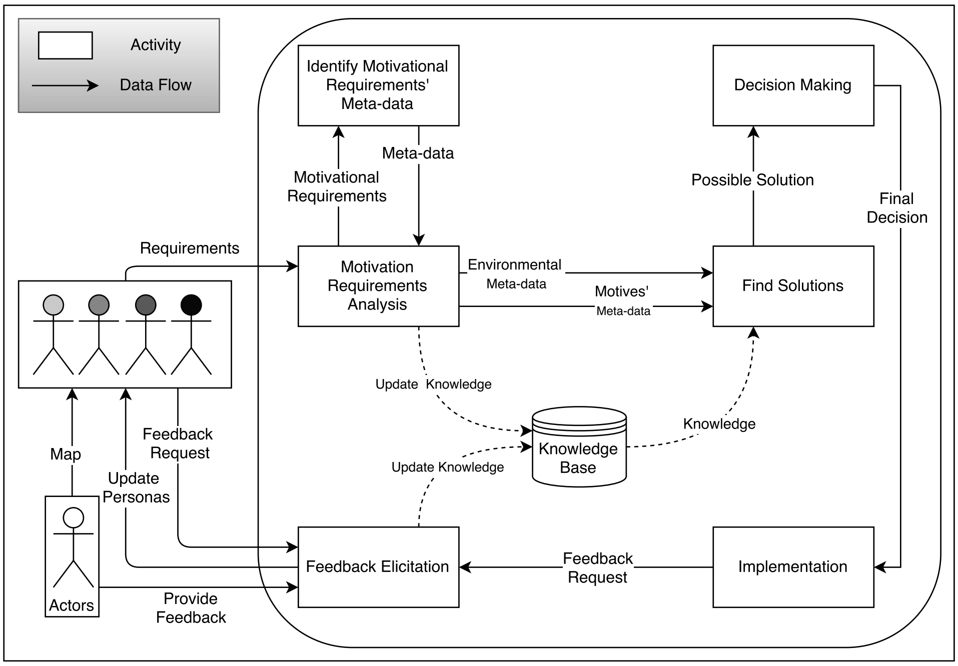


Fig. 7.15 Conceptual Architecture for Developing DM

requirements need to be further analysed by requirements engineers during the motivation requirements analysis. The thematic mapping presented in Table. 7.2, and Table. 7.3 can be utilised to identify the motivational requirements' meta-data related to the environment and the motives. Furthermore, the knowledge-base may be updated at this stage.

Knowledge-base stores information related to personas' preferences and requirements, motivational properties, and possible outcomes of their combinations. Its content originates from new requirements and preferences, plus feedback elicited from actors or employees during later stages of software evolution.

The meta-data, in conjunction with the knowledge taken from the knowledge-base, will be used to find solutions for achieving motivational goals of the BIS. A recommender system can be utilised at this stage to assess the given meta-data and the content of the knowledge-base to find possible solutions. Possible solutions, each with their possible effects on the productivity of employees and also their social and mental well-being within the workplace, will be used in the decision making process of the BIS. Decision makers can choose a final decision based on their policies, business goals, and values.

In the implementation phase, the final decision is used to deploy the DM in the BIS. Besides, to sustain motivation and ensure the compatibility of the personas with the actual users and also to detect any changes over time, feedback elicitation will be initiated. Feedback elicitation phase tries to elicit any modifications that can have an impact on the effectiveness of the design of DM. The feedback stems from technological advances and changes in employees' preferences or the emergence of new hires in the enterprise, which yields the need for software evolution.

Software engineering can use control theory (Carver and Scheier, 1982b) to evolve and adapt the software system with the required changes through feedback loops. It sets a goal, monitors the output via sensors and measures the output with the reference point value. If the delta results in a need for a change in the software, the controller will introduce relevant changes to achieve desired outputs. However, DM is highly reliant on users' perception. It is not a viable decision to rely on technological sensors to capture users' feelings and perceptions. The concept of social sensing (Ali et al., 2011) harnesses the cognitive power of users as monitors. This concept includes the value of the relevant contextual attributes and quality attributes which have not been thought of by requirements engineers or simply have emerged over time.

This chapter advocates the use of control theory and social sensing, in developing DM. This combination will enable a socially adaptive DM solution. The concept of social adaptation (Ali et al., 2012), in the context of this study, could be seen as the ability of the system to gather people's perception on the quality of motives and their related concerns. A well-defined and well-structured requirements and preferences elicitation of the users on DM can form a collective judgement and then decide and enact, or recommend, the best of the available alternatives to reach a motivational requirement or the best of the possible ways to reach a business requirement with higher possibility of an increase in motivation. It is noteworthy that the aforementioned features may seem easy to implement individually, it is a challenge to incorporate all the features into a single development environment and implement and manage the applications as a single project in a team (Pastor and Molina, 2007).

7.9 Automated Reasoning Implementation

In this section, an implementation[1] of the automated reasoning using DMML is presented. For the purpose of this implementation, Java[2] 8 is used as the programming language in line with Eclipse[3] Neon 3 as the IDE. It has been decided to choose an object-oriented programming (OOP) approach to implement DMML to provide the automated reasoning abilities provided by facilitating DMML in conjunction with programming languages. An OOP approach allows for scalability and code re-usability. In addition, it paves the way for an automated journey from the abstract model to the final software product (Pastor et al., 2001). To represent the implementation in UML Class diagram, ObjectAid[4] UML Class Diagram Designer plug-in on Eclipse was used. Using the mentioned tools, a Java tool has been implemented, and the class diagram of the application is derived. The final class diagram of the implemented tool is presented in Fig. 7.16. The application is designed in two major classes, the environment and the motives.

The environment is shaped by its actors, agents, goals, tasks, and personas. The class diagram for the environment is illustrated in Fig. 7.17. In a more focused perspective, the environment includes the relations that these classes have amongst each other, depicted in Fig. 7.18. The class diagram of the relations with regards to

[1]https://goo.gl/nVSh5K
[2]https://www.java.com
[3]https://www.eclipse.org
[4]http://www.objectaid.com

actors is depicted in Fig. 7.19. The class diagram of the relations with regards to the agents is illustrated in Fig. 7.20. Moreover, the class diagram representing the relations with regards to the tasks in the environment is presented in Fig. 7.21.

The motive has three aspects, which two of them need more focused perspective; the reward and the captured information. The reward each motive can offer is presented as a class diagram in Fig. 7.24 and the class diagram of the captured information using a motive is illustrated in Fig. 7.23.

Tool Testing: Algorithm 5 has been chosen for presentation purposes to test the implemented application. To enable the analysis capability of the application, the environment and the motive being added to the environment need to be defined for the computer. As depicted in Fig. 7.25, an environment with a *collaborative* environmental value is set. A leader-board is added to the environment which relies on the group performance of the teams. The leader-board uses competition as an encouragement element, providing a *high* in value reward. The transparency is set to *True* which means that the employees are aware of the policies and strategies that the DM setting has. There is a *low* chance of winning the prize and the points are *pre-defined*. No personal information is captured by the motives. However, a *detailed* work information is stored. Another important aspect is the *social recognition* offered by the motive. This input provides the application with sufficient information to run the analysis and test the BIS against the algorithm number 5 for workplace intimidation. The algorithm is implemented using Java and is presented in Fig. 7.26.

The application is designed to allow the users to choose amongst the available reasoning algorithms. Running the application with the provided input, allows the users to choose the reasoning algorithm. Choosing the "Analysis for workplace intimidation" from the options will result in the detection of a risk of workplace intimidation. A sample of the output is provided in Fig. 7.27.

7.10 Chapter Summary

This chapter provides thematic mappings, forming detailed constituents which shape a DM system in a business context. These thematic mappings can be utilised to systematically design and model DM in enterprises, enabling detection of various potential side effects of introducing a DM into a BIS and help decision makers to find resolution strategies prior to the design and prevent such potential issues from happening. In addition, this chapter proposed a conceptual architecture that can guide software engineers and DM analysts to systematically design DM for the intended BIS, allow detection of the need for DM evolution and evolve it coherently with the changes in end-users' perceptions.

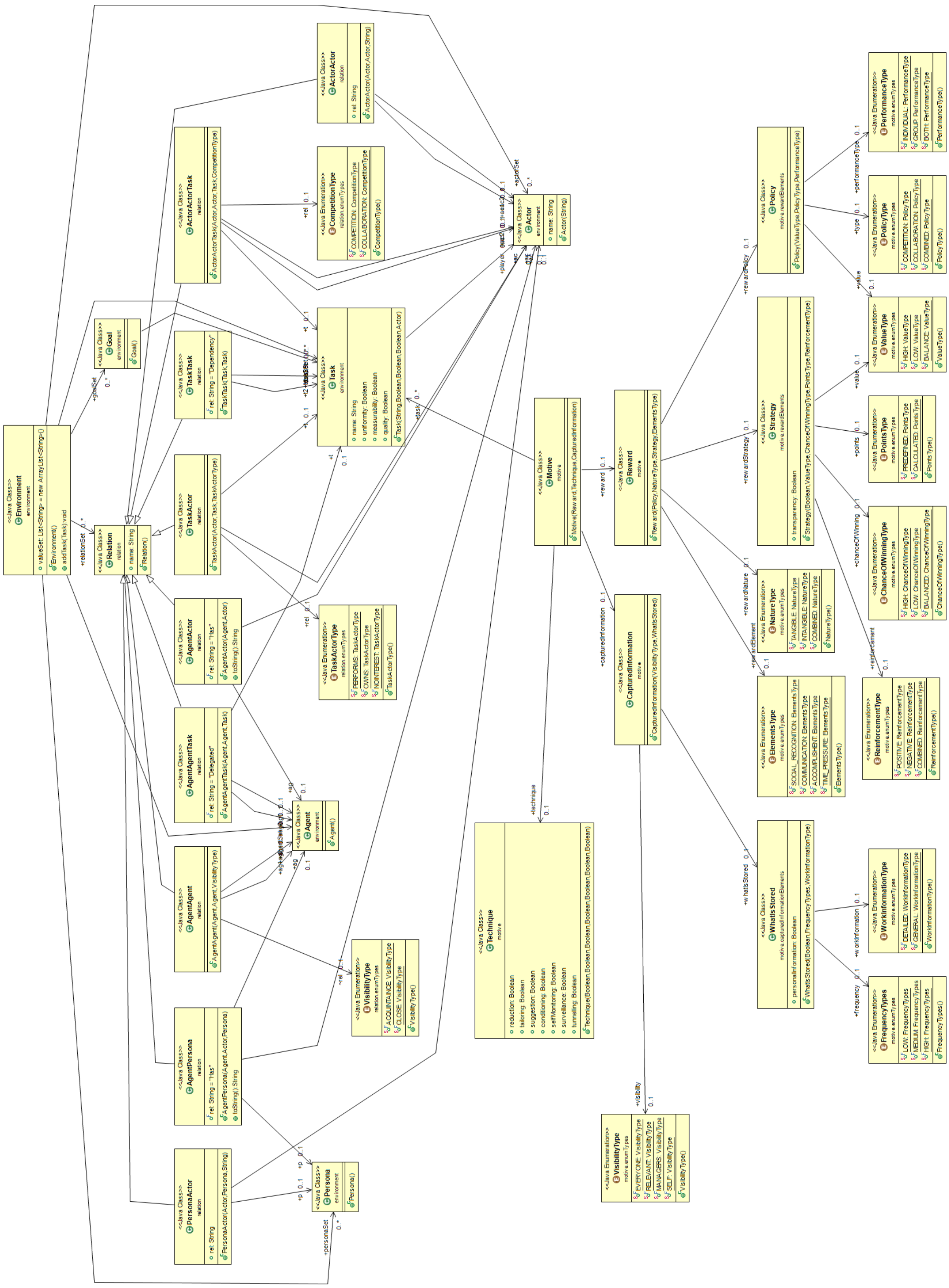


Fig. 7.16 Class diagram for the implemented tool

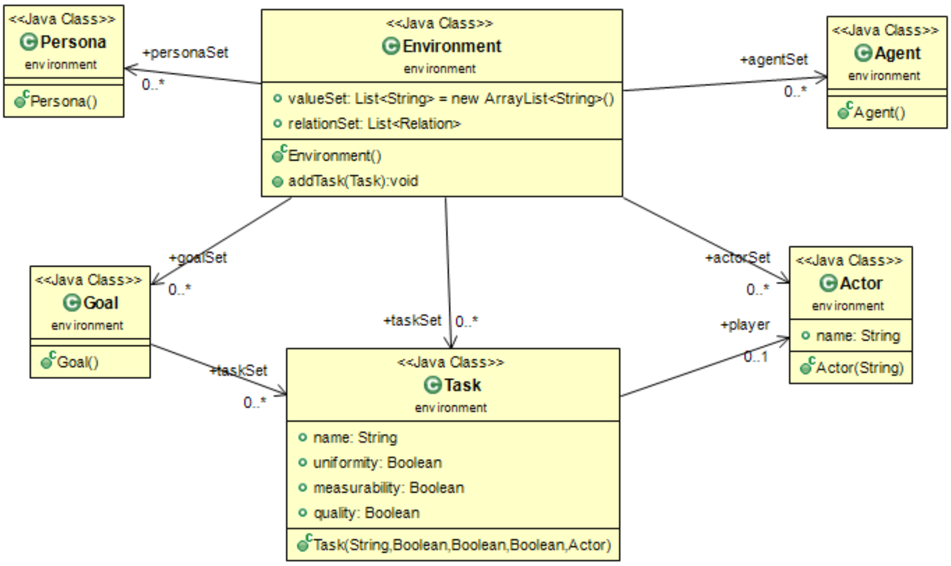


Fig. 7.17 Class diagram – defining the environment

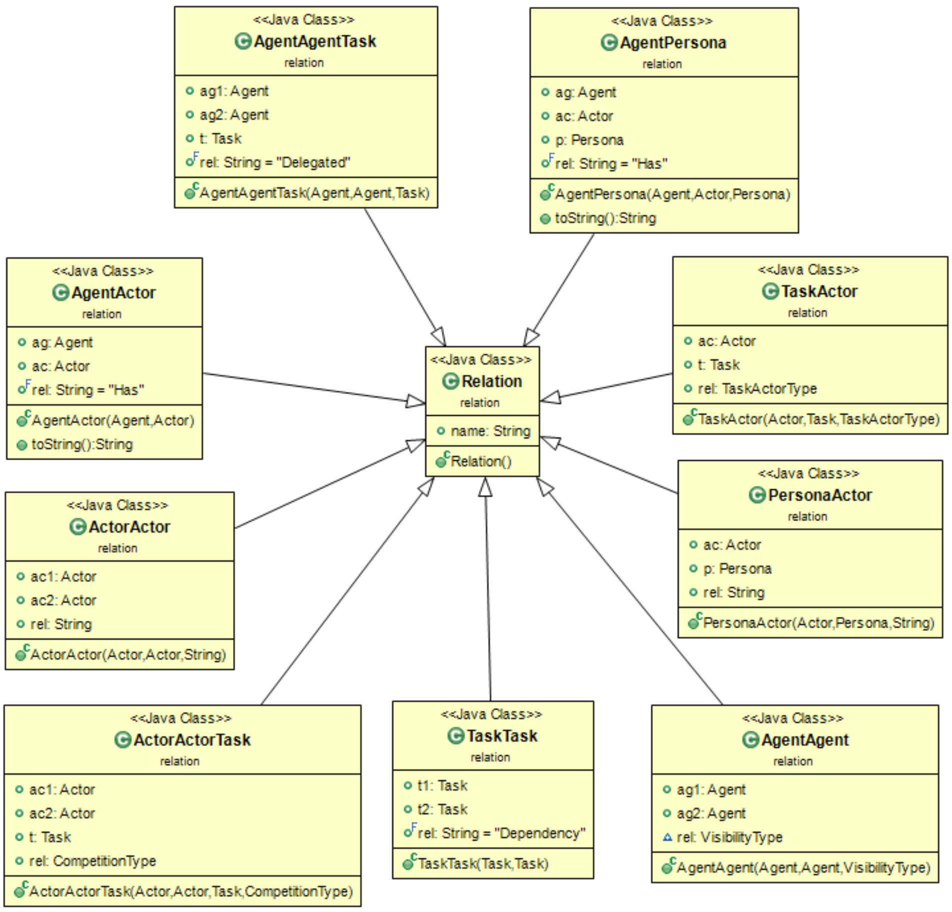


Fig. 7.18 Class diagram – defining the relations

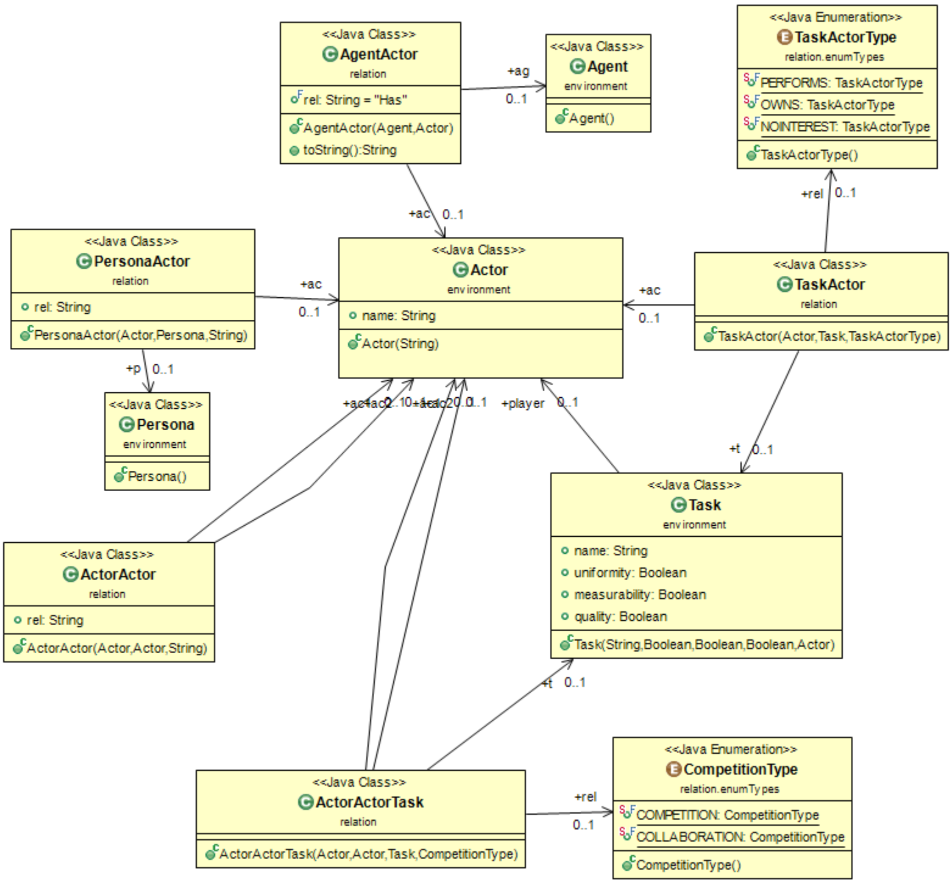


Fig. 7.19 Class diagram – defining the actors' relations

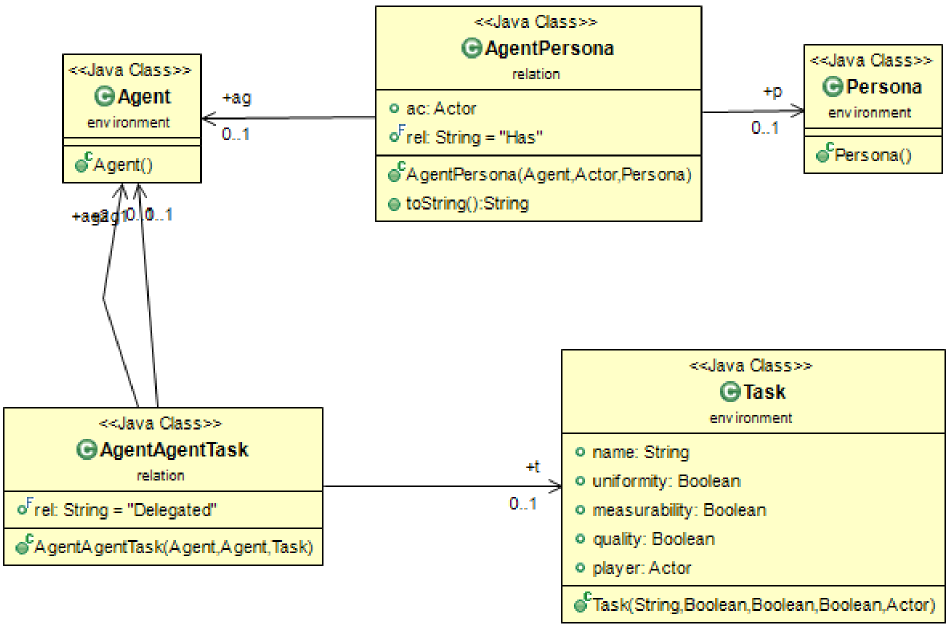


Fig. 7.20 Class diagram – defining the agents' relations

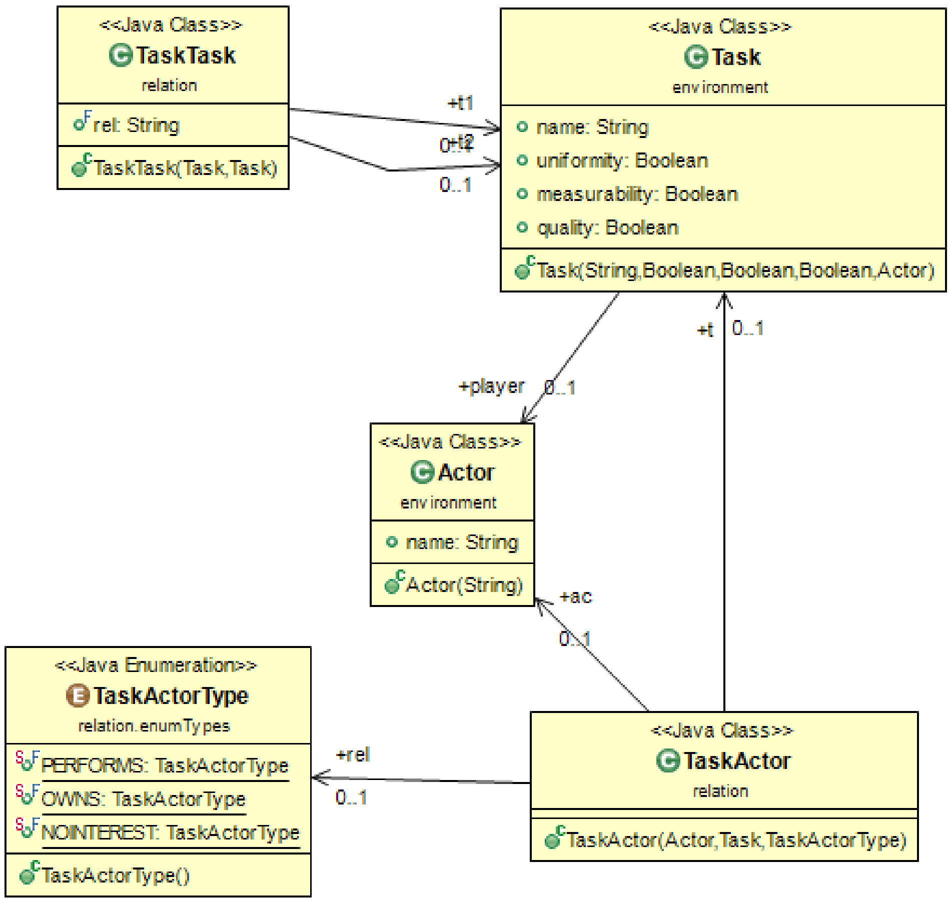


Fig. 7.21 Class diagram – defining the tasks' relations

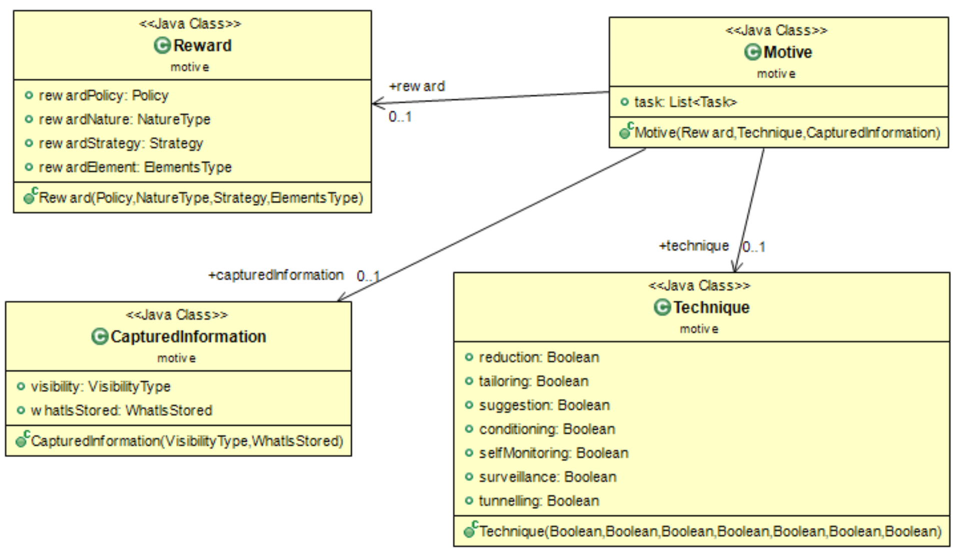


Fig. 7.22 Class diagram – defining the motives

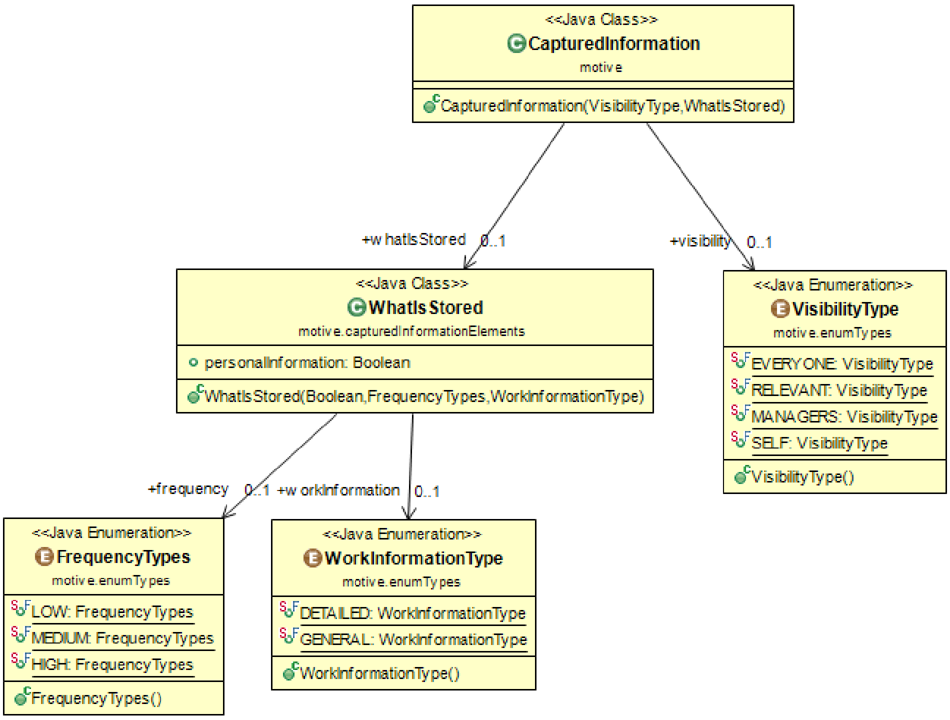


Fig. 7.23 Class diagram – defining the captured information

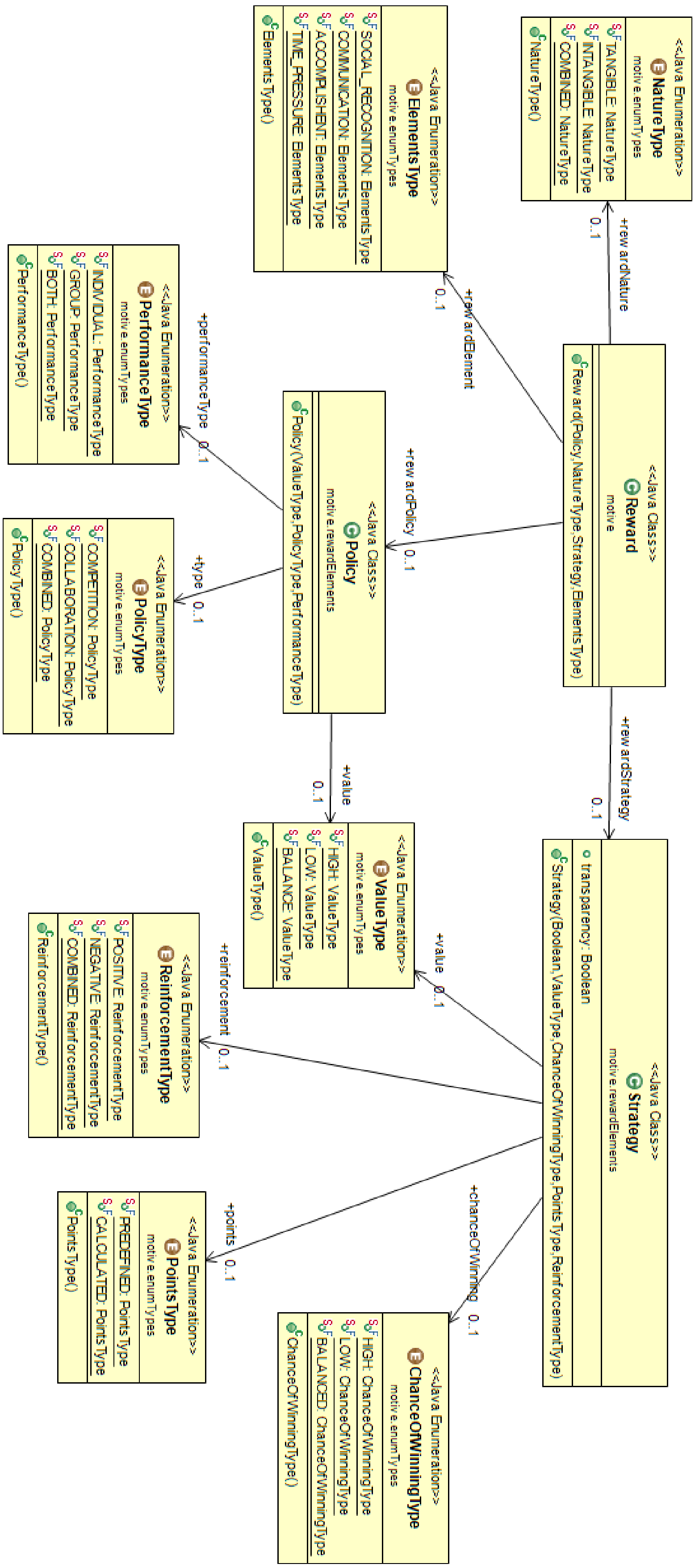


Fig. 7.24 Class diagram – defining the rewards

```java
Environment itDepartement = new Environment();

itDepartement.valueSet.add("Collaboration");

/* Here is the built of the motive */
Policy leadPolicy = new Policy(ValueType.HIGH, PolicyType.COMPETITION, PerformanceType.GROUP);
Strategy leadStrategy = new Strategy(true, ValueType.LOW, ChanceOfWinningType.LOW, PointsType.PREDEFINED,
        ReinforcementType.POSITIVE);
WhatIsStored wis = new WhatIsStored(false, FrequencyTypes.HIGH, WorkInformationType.DETAILED);
CapturedInformation ci = new CapturedInformation(VisibilityType.RELEVANT, wis);

Reward leadReward = new Reward(leadPolicy, NatureType.INTANGIBLE, leadStrategy,
        ElementsType.SOCIAL_RECOGNITION);

Technique tech = new Technique(false, false, false, true, true, true, false);

Motive m = new Motive(leadReward, tech, ci);
```

Fig. 7.25 Implementation testing – input definition

```java
if (tmp == 1 && itDepartement.valueSet.get(0) == "Collaboration") {

    if (m.reward.rewardPolicy.performanceType.equals(PerformanceType.GROUP)
            && m.capturedInformation.whatIsStored.workInformation.equals(WorkInformationType.DETAILED)
            && m.capturedInformation.visibility.equals(VisibilityType.RELEVANT)) {
        System.out.println("Based on the given environment and the motives "
                + "you have decided to add,\nThere is a risk of workplace intimidation");
    }

} else {
    System.out.println("No Risk Found");
}
```

Fig. 7.26 Implementation testing – rule definition

```
Problems  @ Javadoc  Declaration  Console
<terminated> App (1) [Java Application] C:\Program Files\Java\jre1.8.0_131\bin\javaw.exe (Jun 2, 2017, 1:04:40 PM)
Please choose analysis
This application is designed to analyse a given environment and
the digital motivation you are planning to add to the environment.
Please choose action:
1: Analysis for workplace intimidation
1
Based on the given environment and the motives you have decided to add,
There is a risk of workplace intimidation
```

Fig. 7.27 Implementation testing – output

Chapter 8

Evaluation

This chapter aims at empirically investigating the usefulness and effectiveness of using DMML in the engineering processes of adding digital motivation to BISs. To achieve this goal, DMML is evaluated from the perspective of expert and novice software system analysts. This evaluation can help in identifying strengths of DMML and the aspects of it which require improvement. The rest of the chapter describes each of these studies in details.

8.1 Phase A: Evaluation with Novice Software System Modellers

In order to evaluate DMML and the reasoning framework, a two-phase study was performed, a focus group followed by lab sessions performing modelling tasks, which are described in the following subsections in details.

8.1.1 Study Planning

The PICOC technique was followed for this phase of the study. Table 8.1 describes each step of this technique in more details.

Table 8.1 Description of the PICOC for the evaluation of DMML – Novice software system analysts' view

Criteria	**Element**
Population	Final-year undergraduate students in Software Systems Engineering with work experience, e.g., work placements or internships
Intervention	They will evaluate the proposed modelling language (i.e., DMML) and automated reasoning
Comparison	DMML will be compared with goal modelling framework
Outcome	It is expected that the use of DMML in designing digital motivation would be more effective, efficient, useful, and satisfactory in comparison to other goal-oriented modelling languages
Context	The experiment would be carried on in the context of a business information system

Participants

The participants of this study had to meet with the following requirements: (i) Being a final-year undergraduate student in computer science; (ii) having industrial work experience through work placement or internship; and (iii) having the knowledge in requirements engineering and requirements analysis using goal-oriented modelling languages. Choosing final-year undergraduate students can help in assuring a low standard deviation in participants' knowledge, since all students have received the same level of education and support, and have gone through the same assessment criteria. A low standard deviation means that any findings or results are not caused by a delta in the general requirements engineering knowledge of participants.

The participants were provided with a research information sheet and were informed that their participation was voluntary and they could refuse to give their work to the researchers. No information captured during the study could allow the identification of participants.

Artefacts

The following artefacts were used during the studies:

- **DMML Teaching Material:** This consisted of slides and guides which were used to teach DMML to participants. The teaching material is available at Appendix E

- **Scenarios, Models, and Reasoning:** This document consisted of six scenarios where the use of DM in a BIS could lead to issues. The models which described each scenario depicted in DMML, and reasoning for each scenario describing where an issue may arise. Participants should have studied the scenarios which was provided to them in advance in the teaching session. The scenarios, models, and reasoning are available at Appendix E.

- **Participant Answer Sheets 1:** Participants provided their answers to the given scenarios, models, and reasoning in this document.

- **Short Scenario and Reasoning:** This document consisted of a short scenario which participants needed to use. They were asked to model the scenario using goal-oriented modelling language they have the knowledge of and the DMML which was taught to them.

- **Participant Answer Sheets 2:** Participants draw their models in this document and provided issues they found in the design of DM in the given scenario.

- **Design Experience Questionnaire:** This document contained a series of questions, collecting participants opinions on effectiveness, usefulness, ease of use, and their intention of use in the future for designing and modelling DM in a BIS, with regards to the tasks they performed in the lab session.

8.1.2 Study Design

A one-hour teaching of DMML was provided for 19 participants, followed by a one-hour distributed group session with the same audience. In the distributed group

Table 8.2 Material used in the evaluation session – Novice software system analysts

Material	**Description**
DMML Teaching	This consisted of slides and guides which were used to teach DMML to participants
Scenarios, Models, and Reasoning	This document consisted of six scenarios where the use of DM in a BIS could lead to issues. The models which describe each scenario were depicted in DMML, and reasoning for each scenario describing where an issue may arise. Participants should have studied the scenarios which were provided to them in advance in the teaching session
Participant Answer Sheets 1	Participants had to provide their answers to the given scenarios, models, and reasoning in this document
Short Scenario and Reasoning	This document consisted of a short scenario which participants need to use. They were asked to model the scenario using goal oriented modelling language they have the knowledge of and the DMML which was taught to them
Participant Answer Sheets 2	Participants have drawn their models in this document and provided any issues they found in the design of DM in the given scenario
Design Experience Questionnaire	This document contained a series of questions, collecting participants opinions on effectiveness, usefulness, ease of use, and their intention of use in the future for designing and modelling DM in a BIS, with regards to the tasks they performed in the lab session

session, participants were divided into five groups of four or five on separate tables. This setting allowed for inner-group activities on the tasks and group discussions following the activities. The participants were provided with the materials used in the teaching session and a full description of DMML. They were invited for the lab sessions after two weeks from the teaching session. All study sessions including the focus group were conducted using three facilitators logging any insights participants may have provided and helping them perform tasks. The design of this phase of the study is depicted in Fig. 8.1.

Distributed Group Session

Participants were provided with five scenarios that had DM implemented in them. The scenarios provided fictional situations of an IT department of a university, dealing with the front-end and back-end web development teams. The scenarios were designed with embedded intentional issues in them with regards to conflict of interest, bribe for an exchange, free riding, sabotage, and secrecy. They were asked if they could detect any problem in a five-minute time for each scenario. Next, they were provided with a representative model of the scenario depicted using DMML and were asked if they could identify any issues using the provided models. They were given 5 minutes and were asked to write any issues on the answer sheets. Finally, the reasoning algorithms were provided to the participants for each given scenario. Thereafter, they were asked if they could identify the issues using the reasoning and the model.

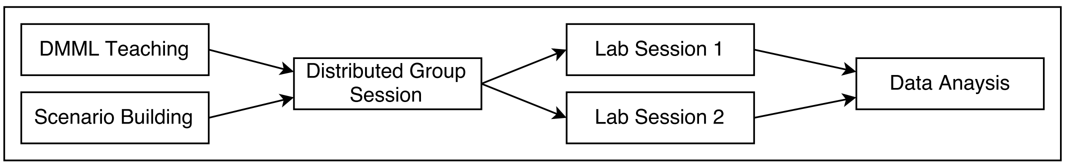


Fig. 8.1 Phase A: Study design

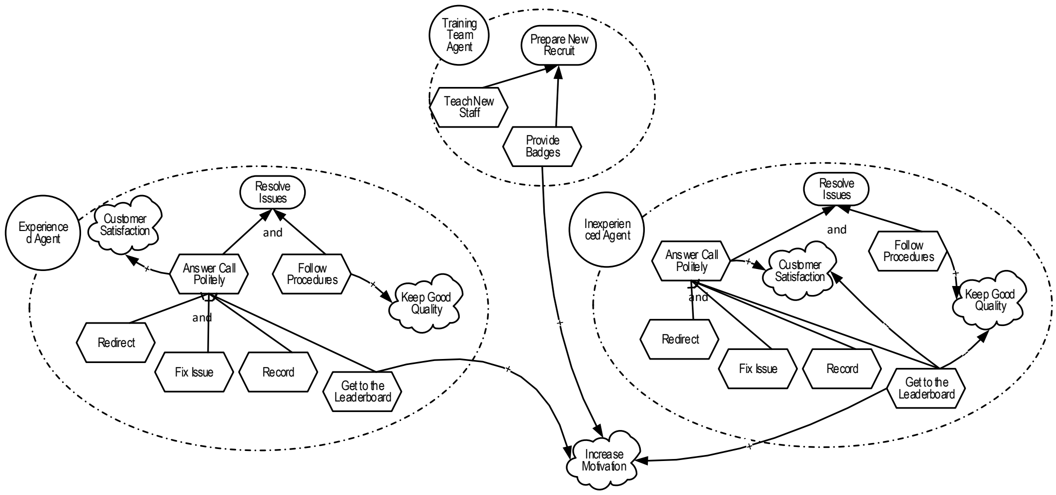


Fig. 8.2 Sample DM design using GORE by novice system analysts

Lab Sessions

The lab sessions were designed for one hour, dedicated to modelling tasks using DMML and *i** modelling framework. The participants of the distributed group session were invited to this phase of the study and 18 of them agreed to take part. Participants were divided into two groups of nine, assigned on a random basis. Each focus group was then divided into three sub-groups of three participants. This session aimed at eliciting the participants perception on DMML in comparison to goal modelling frameworks and their ability to use DMML independently. In the lab sessions, the participants were asked to read through a short scenario of DM implemented in a BIS. They have been invited to draw a model using *i** modelling framework, and another one using DMML. Then, the created models were swapped with other groups and participants were asked to analyse each other's models and find any issues with the design of DM in the BIS for the given scenario. Next, they were asked to read through the reasoning algorithms and re-analyse the models, for detecting any issues. Finally, they were asked to fill in the design experience questionnaire provided for them. Some of the designs created in these sessions are provided in Fig. 8.2, Fig. 8.3, and Fig. 8.4.

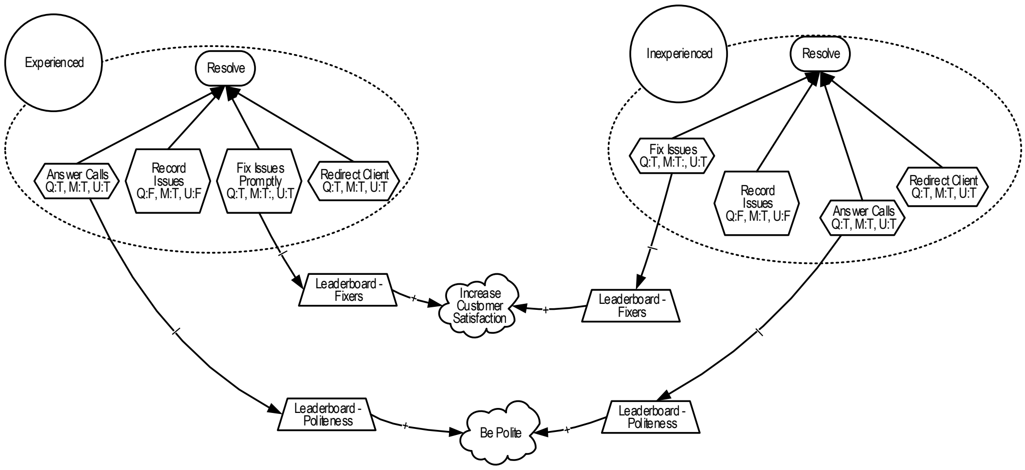


Fig. 8.3 Sample DM design using DMML by novice system analysts - Part 1

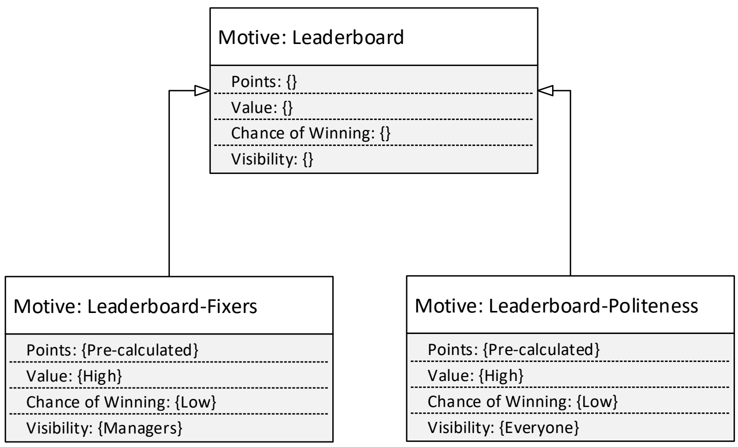


Fig. 8.4 Sample DM design using DMML by novice system analysts - Part 2

8.1.3 Data Analysis

During each of the organised study sessions, the participants' interactions with each other and the facilitators were documented through note taking, taking pictures, and collecting the produced materials. Participants also filled in a questionnaire which helped in eliciting their feedback and observation with regards to various aspects of DMML, provided in the following:

- **DMML easiness of learnability and understand-ability:** In general, DMML provides more concepts and relations which need to be learnt in comparison to the *i** framework. Hence, it requires more cognitive load from its users to understand it and learn it adequately. Participants found DMML to have clear and understandable concepts, which are easy to learn. Despite the extra effort to learn additional concepts, DMML provides easier modelling of DM and the environment in comparison to classic goal modelling. The main expressed difficulty was in the identification, description, and specification of motives. Participants indicated that this required them a thorough examination of the motives' attributes in the meta-model to configure them. This task required a deeper understanding of DM and knowing the characteristics of motives jointly with human behaviour. However, with the help of facilitators, participants were successful in defining motives provided in the scenario with correct settings and values for the attributes. This shows that a more rigours training sessions would be required to enable a more accurate and correct models using DMML. The added value of a comprehensive attributes for motives is the educational power as the list of attributes can act as a checklist to go through, and this helps the analysis and detects ambiguity and obscurity in the specification. For example, in case of a leader-board, the attributes will help designers to be clear whether a competitive or collaborative design should be in place, or the final reward is tangible or intangible, high in value, or low in value. These attributes may be overlooked if the designers are not provided with this checklist and result in an ad-hoc motive.

Participants raised the question of the meaning and usage of *informs* link, and when more than one *informs* link from different actors can end in one motive. This ambiguity was clarified by simply explaining that motives rely on performance information from the tasks and all the tasks which are involved in a motive will inform it. Some participants stated that modelling the relations between actors, which are the *supervision* and *promotion* links may make the models less readable once the system to be modelled is considerably large. It was explained that the whole system does not need to be modelled in a single model and can have various complementary parts.

Based on the observations and the input from participants, it is derivable that despite the heavier cognitive load that DMML requires in comparison to goal modelling, it is easy enough to learn and understand by novice software system analysts. However, there are some areas which demand emphasis and more attention to guide the analysts towards a correct modelling experience. This can be achieved by embedding various examples of DMML modelling different scenarios to disambiguate areas which are prone to mistakes, such as defining and identifying the settings of motives as a UML-like static diagram.

- **DMML expressiveness:** When participants were asked to model the given business scenario using goal modelling, several but not all participants were able to use the i* framework to perform the modelling task. Those who successfully facilitated the i* framework to design a DM system for the scenarios, added motives to an environment as i* tasks. They also used the positive and negative contributions to motivation goals or soft-goals. However, they found i* to be less expressive and harder to model and analyse DM in comparison to DMML, as their models lacked relations and attributes specific to DM, such as tasks' *measurability, uniformity*, or *quality orientation*. Moreover, the use of *i** did not guide them to depict the wide variety of attributes of motives which define motives' setting. The participants indicated that the *i**'s basic model fits the initial stages of modelling where major business decisions are made. However, they found DMML to be more informative towards a DM design by providing more detailed and more specific constructs which could be seen as guidelines. DMML is more expressive in terms of DM and using it allows for considerations which would otherwise been neglected. For example, competitive or collaborative design of a motive, or the high or low frequency of updating information captured by the motive which can have a critical impact on its final acceptability in the BIS from the perspective of end-users. Based on the observations and participants insights, DMML provides more analytic capabilities of a DM design in comparison to goal modelling as a result of being more expressive. Nevertheless, the use of goal modelling is not rejected as it provides a higher level of abstraction and allows the decision makers to cater for the core requirements of the BIS. DMML can be facilitated to help achieving core functional and NFRs of the organisation.

- **DMML efficiency and areas of difficulty:** Participants found it difficult to identify issues with the design of DM when they were given a textual scenario. However, after providing a DMML model of the scenario, some participants could detect DM-related issues. The reason was the emphasis that DMML has on attributes and relations which may be missed when reading the textual description. A number of participants enriched the reasoning already thought by the researcher with new insights, such as the added burden of a task delegation on an agent. This added burden could hinder or cause a delay on other tasks that the agent is involved with, and whether those tasks are part of the DM, can define how the agent would feel about the delegation.

In the distributed group session, participants were asked to perform analysis following the algorithms provided to them and all were able to detect the DM-related issues. In the lab sessions, when participants were asked to model a scenario using *i** modelling framework and DMML, and run the reasoning, majority of them found it difficult to use *i**, stating that DMML complements *i** modelling framework, making it more expressly tailored and enabling more in-depth, crisp, and less subjective analysis concerning DM. For example, the use of DMML allowed the participants to detect the conflict of interest using the algorithm and the model, whereas goal modelling did not provide enough information for the participants to infer such analysis.

- **Intention to use DMML:** At the end of the lab sessions, most of the participants indicated that they intended to use DMML for designing a DM system. The reasons provided by the participants were mainly with regards to the additions of DMML to the goal modelling, such as modelling motives as separate entities in the system, enabling different reasoning based on various characteristics of motivational techniques that would be implemented in a BIS. These additions can guide the design of DM towards satisfying the motivation requirements of the BIS in a less subjective and more in-depth way. This is achieved through consideration of the organisational structure, business tasks and goals, detailed definition of motives, various relations amongst the constituents, as well as end-users' preferences via personas.

  All 19 participants of this study were part of a class of 30, which were asked to model a gamified call centre as part of their final assignment for their Software Systems Modelling module. They have been invited to use the classic versions of goal modelling, e.g., *i** modelling framework, and given a chance to use DMML as an auxiliary aid. The documentation and teaching material used in the study sessions were made available online for all the students. At the end of the semester, 21 of the assignments have used DMML as a modelling language for designing the gamified call centre. Due to anonymity processes taken in the data collection, it is not known to this research how many of the participants have decided not to use DMML and how many of the non-participants have decided to use DMML in their assignments.

As a general limitation, it has been noticed that DMML does not cater for the sustainability of motivation and its evolution needs. Even a successful design of DM may become outdated, and users may lose their interest in what DM offers. This problem is valid, and evolution of DM is crucial for sustaining employees' motivation and engagement which must be addressed in DMML's next version through regular monitoring of end-users' feedback on DM.

In addition, a few frequent and recurring mistakes have been identified during this phase of the evaluation, presented in Table. 8.3. One of the frequent mistakes made by the novice system analysts was not providing the detailed settings of the motives they have provided in the model. DMML provides a UML-like static diagram which allows the definition of the motives in granular details. However, some of the participants neglected to provide this information in their models. This negligence prevents a correct use of DMML, and limits a considerable proportion of properties for analysis. This issue is expected to happen as people who are new to the domain of DM may not realise the importance of the information collected and defined in the process of creating the motives in this way. This issue can be prevented by involving the domain experts in this stage of the design and putting more emphasis on the importance of identifying and defining motives in granular details and providing more examples of situations where these detailed information can help making critical decisions in terms of designing DM.

Another frequent mistake that the participants made was mixing DMML with other extensions of goal modelling languages and frameworks, such as Tropos, see

Fig. 8.5. This mixture may not necessarily result in a wrong model, though it is most likely to produce a disorderly model which is not easy to read and follow. This issue is caused by the lack of clarification and scarcity of a complete system modelled using DMML to provide the users with a better understanding of how DMML should be used in a larger scale.

Next issue was the negligence of task attributes by participants, see Fig. 8.6 for an example. Analysing the models produced by novice software analysts, it is noticeable that it is likely for them to ignore defining the attributes of the tasks. Lack of the attributes of the tasks prevents a complete analysis of the model, and in cases may also result in an incorrect analysis, e.g., allowing a competitive motive for a quality oriented task, that is hard to measure and also is subject to human judgement. For example, in Fig. 8.5, a leader-board is assigned to a task for taking clients' calls. It is arguable that taking the calls of customers is quality oriented as "increasing customer happiness" is a soft-goal in this scenario. Naturally, leader-boards are competitive be definition, unless designed and declared otherwise such as an anonymous leader-board, and introducing a competitive motive for a quality oriented task is not advised as it may persuade people to perform the task in a cursory manner which can hinder the customer satisfaction soft-goal. One reason for this issue could be its similarity with other goal modelling frameworks and calls for a better tutorial of DMML and more emphasis on the importance of DMML specific constituents.

Another mistake which was observed during this phase of the study was that participants occasionally did not draw the relations between the roles. This oversight may have a significant impact on the analysis of the model and the design since it can affect the result of the reasoning algorithms and prevents a complete analysis. This calls for the involvement of the software designers with managerial expertise which understand the importance of organisational structure on the outcome of a DM design. Next identified mistake was that participants have proposed a number of personas in their designs, but did not provide the description of the personas. Personas are useful when they are able to communicate information about the users to the designers, aiming at helping the design of the DM to be closer to what end-users prefer and require. Not providing the description of the personas will invalidate their use in the model as they do not carry any useful information. However, providing the description of the personas requires substantial preferences elicitation and psychological expertise which was not available for the novice analysts.

Furthermore, it was noted that some participants used incorrect input values, damaging the consistency of the models, and preventing a proper automated analysis. For example in Fig. 8.7, the visibility of the leader-board is set to both *individual* and *everyone*. This should not happen as once the visibility is set to individual, it excludes all the other people from accessing the information, and once the visibility is set to everyone, it includes all people to have access to the information. These two settings are contradictory and cannot be used concurrently on an individual motive. In addition, it was observed that some participants used the links for the motives incorrectly, instead of having the *informs* link providing information from tasks to motives, they used other forms of the informs, see Fig. 8.5, which does not carry correct information with regards to the syntax of DMML. This mistake will cause a failure in any form of reasoning algorithms and automated analysis. These issue arises from a lack of understanding on how DMML works and how it can be used for analysis purposes, which means a better syntax and formal specification is required and a more thorough introduction and teaching of DMML must be given to the system analysts before using DMML.

The last frequent mistake that was identified during this phase of the research was the negligence of the instance level modelling by participants. Although the abstract level modelling of DMML allows the analysis of the model at the organisational level, providing the instance level information would allow more detailed and accurate analysis of the system as a whole. However, it should be noted that instance level information is not always available and its elicitation requires substantial effort. One reason for not using the instance level modelling constituents is the elicitation load that is required.

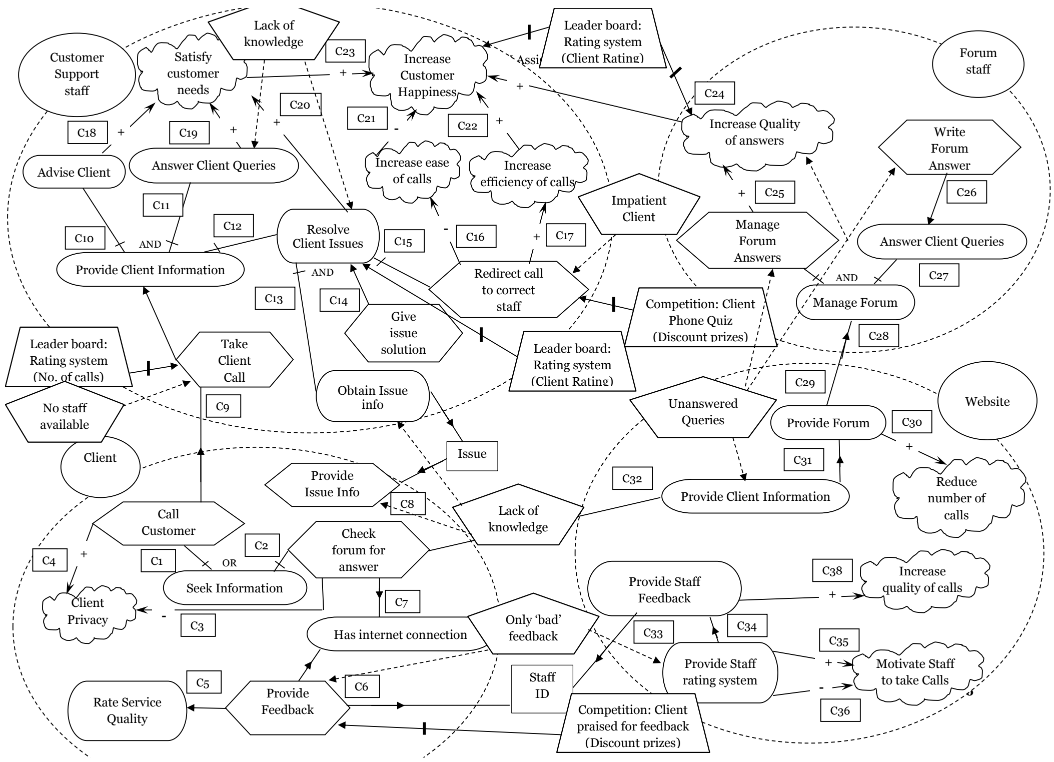


Fig. 8.5 Sample 1 – Excerpt from novice system analysts assignment

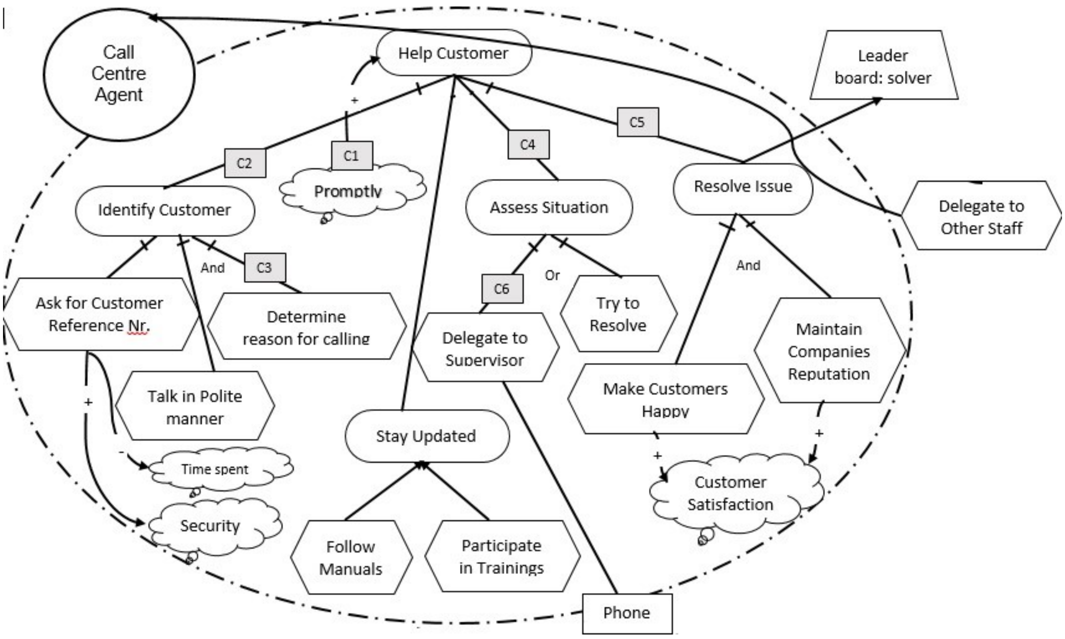


Fig. 8.6 Sample 2 – Excerpt from novice system analysts assignment

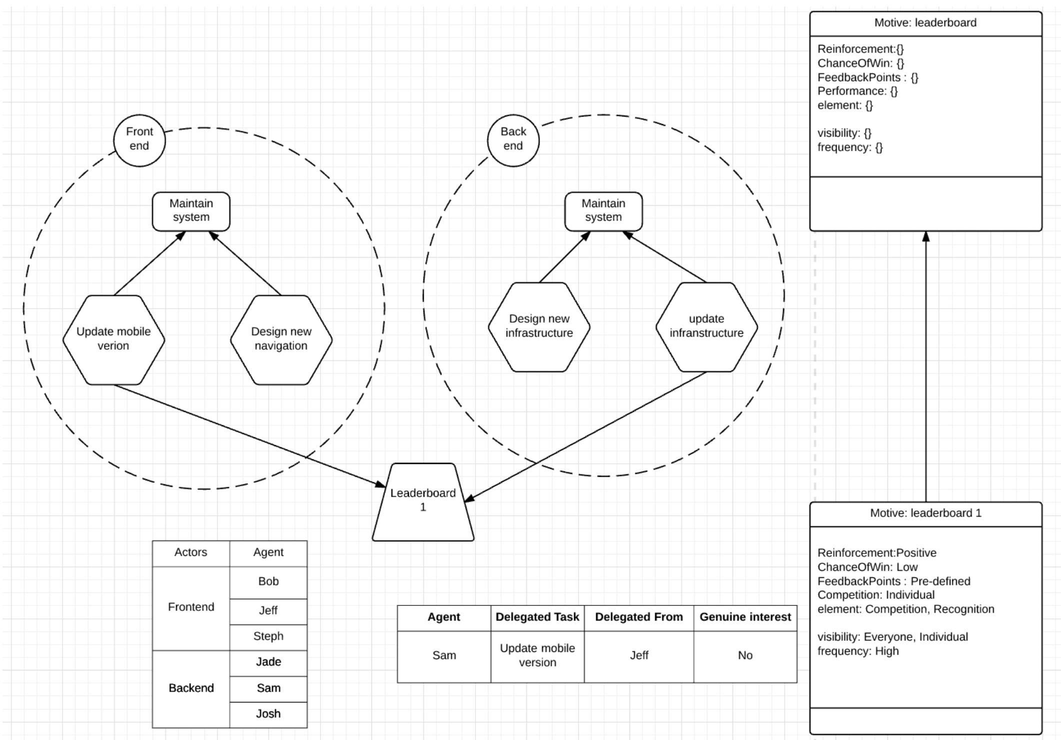


Fig. 8.7 Sample 3 – Excerpt from novice system analysts assignment

Table 8.3 Frequent mistakes made by novice system analysts while using DMML

Mistake	**Reason**	**Consequence**
Not providing the settings for the used motives	Lack of domain experts involvement and insufficient training	May hinder the analysis or divert the analysis results from its actual points
Mixing with other modelling languages	Syntax similarity, insufficient training and modelling examples	May create information overload and cause confusion
Neglecting the task attributes	Syntax similarity with other modelling languages, insufficient reasoning algorithm examples	May result in incomplete or incorrect analysis
Missing relations between roles	The need for involving managerial expertise	May result in incomplete ir incorrect analysis
Not providing the description of the personas	Preferences elicitation load and lack of psychological expertise	May lead to incompatible design of DM for the end-users
Incorrect input values for the metamodel	Syntax issues, incomplete formalisation, and lack of examples	May hinder the automated analysis
Incorrect notation	Syntax similarity with other modelling languages and lack of examples	May mislead the reader and result in incorrect analysis
Neglecting instance level modelling	Information elicitation load	May hinder the analysis or result in incomplete analysis

8.2 Phase B: Evaluation with Expert Software System Modellers

To evaluate the usefulness and effectiveness of DMML from the perspective of experienced software system analysts, empirical qualitative research methodology approach was followed, conducting interview sessions leading to two parallel focus groups, which are described in the following subsections in details.

8.2.1 Study Planning

For planning the evaluation study for this phase, the PICOC technique (Moody et al., 2002) was employed. Table 8.4 describes each of the steps for this technique in details.

Participants

This study required two types of participants; managers of a BIS and experienced software systems analysts. The managers would be involved in the requirements elicitation process and analysing the final artefacts created during this phase of the study. The experienced software system analysts would be involved in designing DM for the intended BIS using DMML and goal modelling frameworks. The selection criteria for the managers is: (i) being employed by a common BIS; (ii) have executive and decision making responsibilities. The software system analysts required to to have: (i) a minimum of five years experience in software system modelling; (ii) minimum MSc in computing; (iii) familiarity with DM; (iv) and complete understanding of goal modelling and in particular, the *i** modelling framework.

All participants were provided with a research information sheet and were informed that their participation was on a voluntary basis, allowing them to withdraw from the study. To avoid the identification of the participants, all personal information from the study data were removed and anonymised.

Table 8.4 Description of the PICOC for the evaluation of DMML – Expert software system analysts' view

Criteria	**Element**
Population	Managers of a BIS with the intention of integrating DM within their workplace and experienced software system analysts with a minimum requirement of an MSc in computing
Intervention	Managers will provide the study with motivation requirements for the BIS and the software system analysts will evaluate the proposed modelling language (i.e., DMML) and automated reasoning
Comparison	DMML will be compared with goal model, and in particular, the i* modelling framework
Outcome	It is expected that the use of DMML in designing digital motivation would be more effective, efficient, useful, and satisfactory in comparison to other goal-oriented modelling languages
Context	The experiment would be carried on in the context of the business aspect of a real educational organisation

Artefacts

To conduct this study, the following artefacts, available at Appendix E, were used during the sessions:

- **Requirements Elicitation Template:** This document consisted of a set of questions to gather the motivation requirements of the intended BIS, elicit which parts of the workplace requires DM, who will be the users of the designed system, and what is expected from the designed DM system.
- **DMML Teaching Material:** This consisted of a complete guideline for DMML and a summary of DMML in the form of presentable slides which were provided to the participants to teach DMML.
- **DM Teaching Material:** This consisted of a set of guidelines available in the literature which is being used in the industry. This guideline was summarised

in the form of presentable slides for participants. These were provided to the participants to have a common knowledge on designing DM.

- **Requirements Document:** This document provided the participants with the motivation requirements of the BIS and allowed them to design a DM for the intended organisation.
- **DMML Session Answer Sheet:** This document consisted of questions which guided the DMML session participants through modelling the requirements of the BIS and designing a DM system to address the requirements.
- **GORE Session Answer sheet:** This document consisted of questions which guided the participants in the GORE focus group session through modelling the requirements of the BIS. These questions allowed the modelling of the requirements and designing a DM system to address the requirements.
- **DM Designs:** This artefact consists of two DM design created in the focus group sessions. These two designs were provided to the managers for their opinion.

8.2.2 Study Design

To evaluate DMML, it has been decided to apply DMML in a BIS which intends to integrate DM within its workplace. As a result, this study was performed in three main steps: motivation requirements elicitation; modelling and design; manager opinion elicitation. The design of the study is illustrated in Fig. 8.8 and each of the steps are described as follows:

Motivation Requirements Elicitation

To perform this step, a set of requirements elicitation questions were used to collect motivation requirements of the BIS, the stakeholders, the business goals, priority

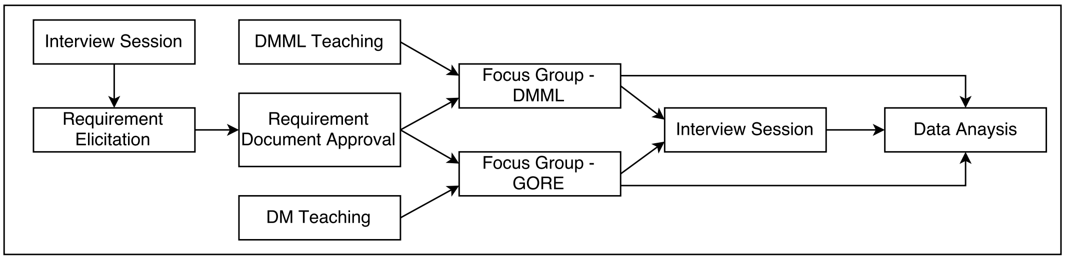


Fig. 8.8 Phase B: Study design

of the requirements, and monetary expenses which could be used in the rewarding system. Three of the executive managers in the computing department of the BIS were approached for the interview sessions. All the managers held a degree in computing and had knowledge with regards to software systems modelling and software design life cycle. The privacy policies of the BIS did not allow for any video or voice recordings and the research was limited to taking notes during the interview sessions. Prior to the interview sessions, the participants were provided with research information sheet and they signed the consent form, allowing their anonymised data to be used in this research. The interview sessions were conducted in a semi-structured way, allowing flexibility in the order of the questions being asked and discussing the situation where necessary. The sessions were limited to 30 minutes each from the managerial team. To ensure the correctness and integrity of the notes taken during the interview sessions, each participant was provided with the final notes for their approval.

Modelling Sessions

To evaluate DMML, it has been decided to compare its usefulness and effectiveness in modelling and designing DM for a BIS with the *i** modelling frameworks. To achieve this aim, ten experts in software systems modelling have been invited to take part in this research. The experts were divided into two separate groups, each performing different modelling tasks. This helped in eliminating the learning effect bias towards the latter sessions. To remove the bias in assigning the experts in the sessions, the participants were ordered by their surname and divided into two groups of five. The first five participants shaped the focus group which would work on goal oriented requirements engineering (GORE) and specifically the *i** modelling framework. The second group would use DMML as the modelling language to model and design a DM system for the intended BIS. All participants were provided with the research information sheet and they provided the research with their consent to use their anonymised data. The performed sessions are described as follows:

Focus Groups – GORE This session was focused on modelling and designing a DM for the intended BIS guided by the requirements document. All participants in this focus group were provided with a set of guidelines providing the common practices used in the industry two weeks prior to the session. In a one week time, a two hour long tutorial session was conducted, allowing the participants to gain the same minimum level of understanding with regards to DM and ask questions related to the guideline and remove ambiguities in their understanding.

In the focus group session, all participants were provided with a set of questions which guided them through modelling the requirements document and design a DM system that can address the motivation requirements. Participants discussed amongst each other and modelled the given BIS using the *i** modelling framework. Once the modelling finished, participants started to design a DM for the given requirements document. The participants documented the model and the design of the DM during the session. In case an idea was controversial, the decision with the higher number of agreements was considered as the final decision. The facilitator would intervene to disambiguate the understanding from the requirements document where necessary. The session lasted for two hours and the final model and the design of the DM using the *i** modelling framework was approved by all participants.

Focus Groups – DMML This session was focused on modelling and designing a DM for the BIS using the requirements document. To ensure the familiarity of all participants with DMML, the full guideline of the modelling language was provided to the participants two week before the focus group session. In a one week time, all participants of the DMML session were invited to take part in a two hour long tutorial session on DMML. This session has provided the participants with opportunities to learn DMML in more details and also ask any questions with regards to the language to remove ambiguities in their understanding.

In the focus group session, the participants were provided with a set of questions which were designed to guide them through the steps required to model the requirements document and design a DM to address the set of requirements. Participants discussed amongst each other and modelled the given scenario using DMML, allowing them to start the design phase of the study. Participants were asked to use the model depicted using DMML and come up with a DM design which can address the requirements provided in the document. In case a unanimous decision could not be made, participants voted on the ideas and the idea with the higher vote would be accepted as the final answer. Where there was an ambiguity in the requirements document, the facilitator would intervene and help removing the ambiguity. The session lasted two hours and the final model and design of the DM for the BIS was approved by all participants.

Design Approval

The managers participated in the requirements elicitation phase were approached for their opinions on the models and the designs produced in the two focus group sessions. The models and designs from the two focus group sessions were further analysed using DMML for issues with the designs. First, managers were provided with the results from the GORE focus group and their opinions and issues with the models and design were documented. Second, the results from the DMML focus group session were provided to them and their opinions and issues with the models and design were documented. Lastly, the reasoning using the DMML were provided to them and their opinion were documented. Each session was limited to 30 minutes and due to the organisational privacy policies and restrictions, no video or voice recording could be performed. However, the participants notes were documented carefully and at the end of the interview sessions, the managers asked for their approval of the notes taken to ensure correctness of the elicited opinions.

8.2.3 Data Analysis

During the focus group sessions, all participants' interaction with each other and with the facilitator were observed and documented. Participants also enriched this study with their observation about modelling motivation requirements using DMML and GORE frameworks. Also, the result of the investigation was provided to the managers, and their opinion was elicited and analysed. The results of these observations and analysis are presented in the following:

Ease of use:

The modelling of the given environment using the *i** framework was very straight forward for the analysts as it is a well established framework. They unanimously identified the actors, functional requirements, non-functional requirements, and tasks for all motivation requirements. However, one challenge to tackle for them was the addition of motives to the model to address the motivation requirements of the BIS. Although it was possible to add the motives as additional tasks in the design, it was stated that this would be very descriptive, resulting in an unreadable final model, or a large supplementary document describing how each added motive should behave. The analysts stated that there should be an "easier way" to model the motives. The addition of the motives "are very descriptive and confusing at the end". This issue is expected as the lack of motivation related constituents in a modelling language limits the analysts to available constituents and relations. However, this does not mean that a digital motivation specific modelling language resolves this issue without any side effects. In the case of DMML, analysts had to put more effort in the modelling of the environment in comparison to goal modelling. The reason for this additional work load is that DMML relies on more data from the environment and the motives, and a higher level of effort towards modelling DM using DMML was expected. In addition to more work load, despite the straightforward identification of the actors, functional and non-functional requirements, tasks, and relations between the constituents in the environment, less unanimity was observed in defining the attributes of the tasks. The disagreements arise from the qualitative nature and the subjectivity of the attributes such as measurability of a task. In several instances, there was a need for voting and a collective decision-making process to overcome this problem. The better solution to this issue is to elicit the information from the correct stakeholders in the environment, which in the case of this study, would have been the quality assurance department of the BIS.

Effective use:

While observing the GORE modelling session, it was noted that a considerable amount of time was being spent on deciding how to depict the digital motivation solution and embedding that in the model instead of deciding the compatibility of the motive for the given situation and context. One participant mentioned that it is challenging to define the "behaviour of the motives". There have been some discussions on possible design issues and conflicts which may be introduced by the addition of the motives to the environment. These discussions stemmed from the digital motivation tutorial, where a number of issues with regards to the introduction of digital motivation to an environment were listed. For instance, one of the participants mentioned that involving the managers and staff in the "same leaderboard" is problematic based on the "personal experience" in which the participant had. However, the participant mentioned that using the *i** framework, there is no easy solution to depict, represent, and detect this situation. It was also stated that despite their "feeling" of incompatibility of some of the motives with the environment, it is not clear to them that which characteristics of the motives can cause those issues and how these issues can be detected or prevented. Moreover, it was mentioned that DM could be perceived differently depending on the various personality of its users. Participants agreed that "no single person" in the focus group session would have "similar likings" of the DM. As a result, a user-centred design approach must be adopted to enable the consideration of end-user preferences and "adaptability" to user requirements.

On the other hand, despite the higher effort and cognitive load required by DMML, richer and more in-depth discussions on finding a DM solution was observed during the focus group session. Modelling the environment using DMML and providing the constituents of motives to the analysts allowed a richer discussion on the compatibility of each motive they planned to add to the task and environment. The *quality-orientation* of tasks had started discussions on whether pressurising motives such as "time limits" should be introduced. The *measurability* of tasks enabled discussions on how the points produced by DM should be *calculated*. Also, it was discussed whether it is a wise decision to add *competition* for tasks which are challenging to *measure* or are *subject* to human judgement. Moreover, there were discussions about the *visibility* of each motive and the *information gathered* by each motive which played a critical role in deciding who the audience of a motive could be. There have been some discussions on the relevance of *actors' relations*, especially the competition or collaboration relation on tasks and their compatibility with the motives added to those tasks. The reason that DMML seems to be more effective in designing a DM for a BIS is that it provides relations, constituents, and attributes which are specific to motivation in its digital form. These additions allow a more guided perspective of the requirements and allow more in-depth analysis of the motivation requirements for the intended BIS.

It was raised during the DMML session that it would have been useful if DMML could consider the time constraint on the tasks where relevant. Despite the presence of this element on some tasks, its consideration would not benefit the modelling of motivation. Tasks which have their time constraints at an organisational and business level should be performed within the given time regardless of digital motivation. A solution to embedding the time constraint in the design of digital motivation is to add the time constraint as an individual motive to the task, and designing it using the provided meta-model. One other participant stated that the consideration of resource dependency could be beneficial for DMML, allowing it to capture more properties. However, this research has the assumption that the resources are equally distributed amongst the users, and this requires to be investigated in future studies.

Managers' Assessment

Both models created in the focus group sessions were presented to the managers for their opinions to evaluate the usefulness and effectiveness of DMML. The aim of this process was to identify which model provides better analysis of the situation and leads to a better design of digital motivation. All the three managers are proficient in computer science and hold a degree in computing, with two holding MSc in Computer Science and one holding a BSc in Computer Software Engineering.

The managers were asked to study the models in details, provide their opinions, and see if they can find any flaws with the designs. They have been invited to choose one of the models as the candidate design for the final implementation of DM in their

BIS. Moreover, they were asked to provide improvements to the candidate model with reasons to why they made those changes. The result of this stage is as follows:

GORE Model and Design All the managers found the models created using the *i** framework to be useful, and informative. They mentioned that it divides the business goals and assigns tasks which are required to achieve the goals distinctively. The model provided a general understanding of the proposed DM system. However, the managers found it difficult to imagine the final design. It was stated that one "has to look for the designs and map them to the tasks in mind", which in case of a large system requires "a lot of brain work". Moreover, it was pointed out that the motives which are added to the tasks do not provide very informative information. The first comment that was made by all managers was "how the points are given", emphasising that it is difficult to quantify various educational tasks. Also, it was added that there is an excessive use of leaderboards in the design. They stated that there is no sufficient information with regards to how the leaderboards will behave in the environment. Nevertheless, considering the general understanding of a leaderboard, all the managers disagreed with this setting. They believed that leaderboards are not suitable for an educational environment. They reasoned as shifting the main focus of the environment from collaboration to competition is against the nature of an educational organisation, hindering the learning experience of the learners. This competitiveness can damage the reputation of the organisation in the long term. Another issue which was mentioned during the interview sessions were the audience of the collected information, emphasising that the learners "must not" have access to any part of the data. The managers stated that they do not find any section of the model allowing them to understand whether the students will have access to this information.

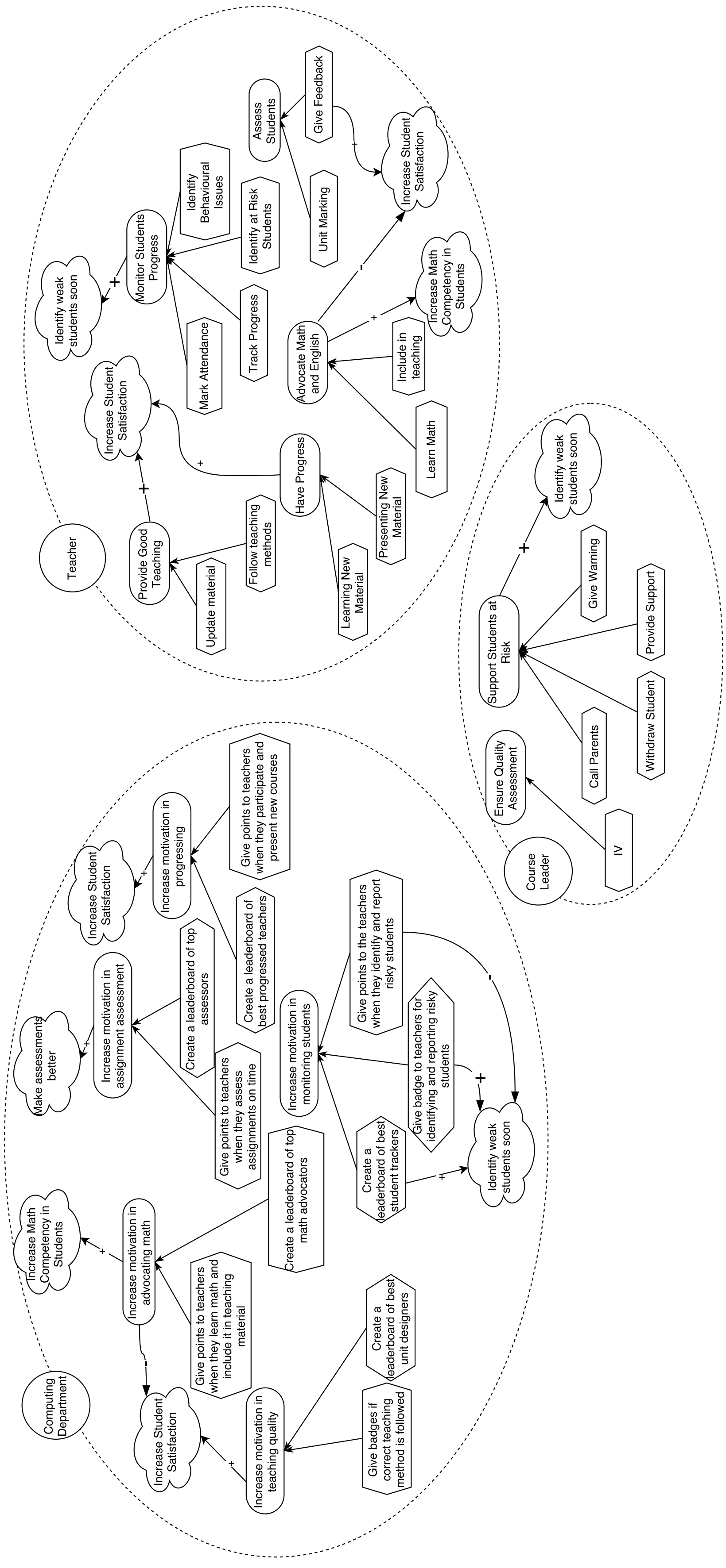


Fig. 8.9 Digital motivation designed in the GORE session

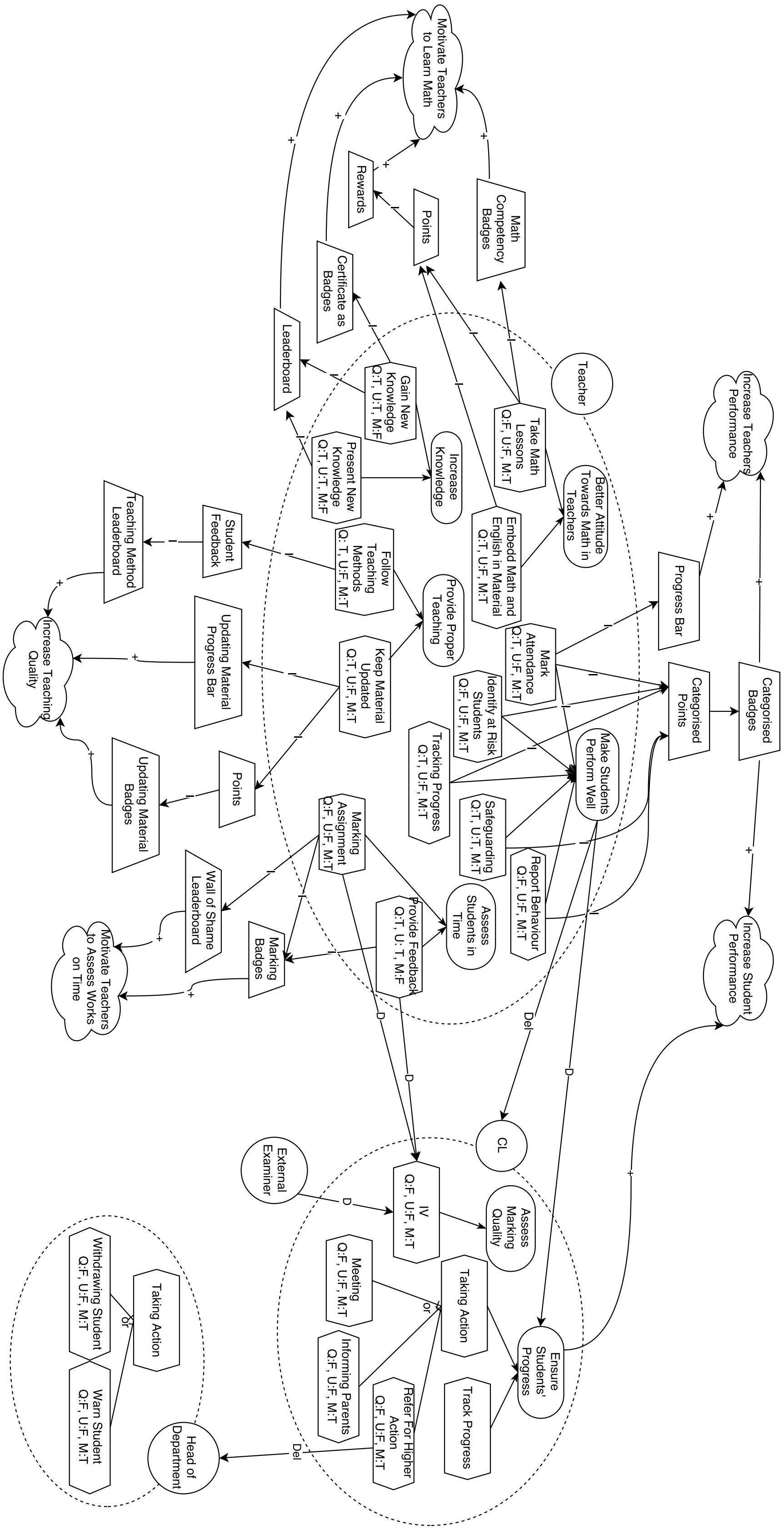


Fig. 8.10 Digital motivation designed in the DMML session – Environment part

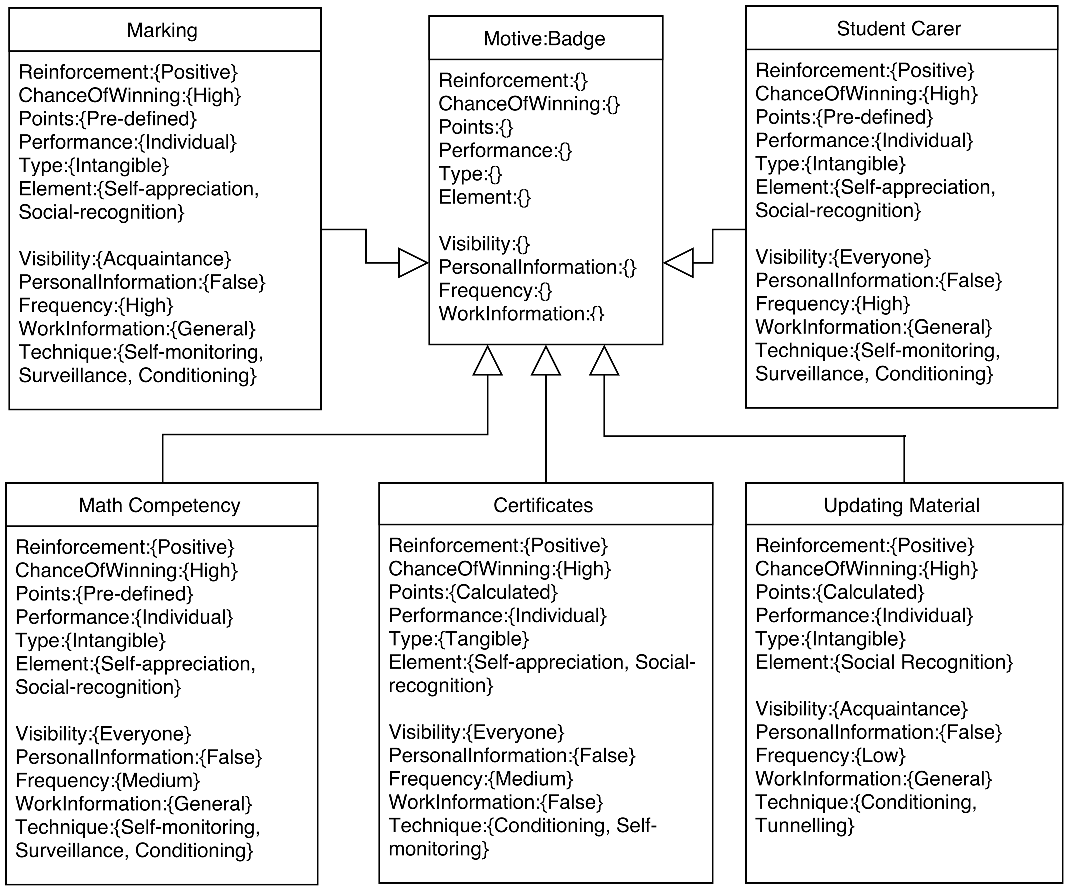


Fig. 8.11 Digital motivation designed in the DMML session – Badges as motives

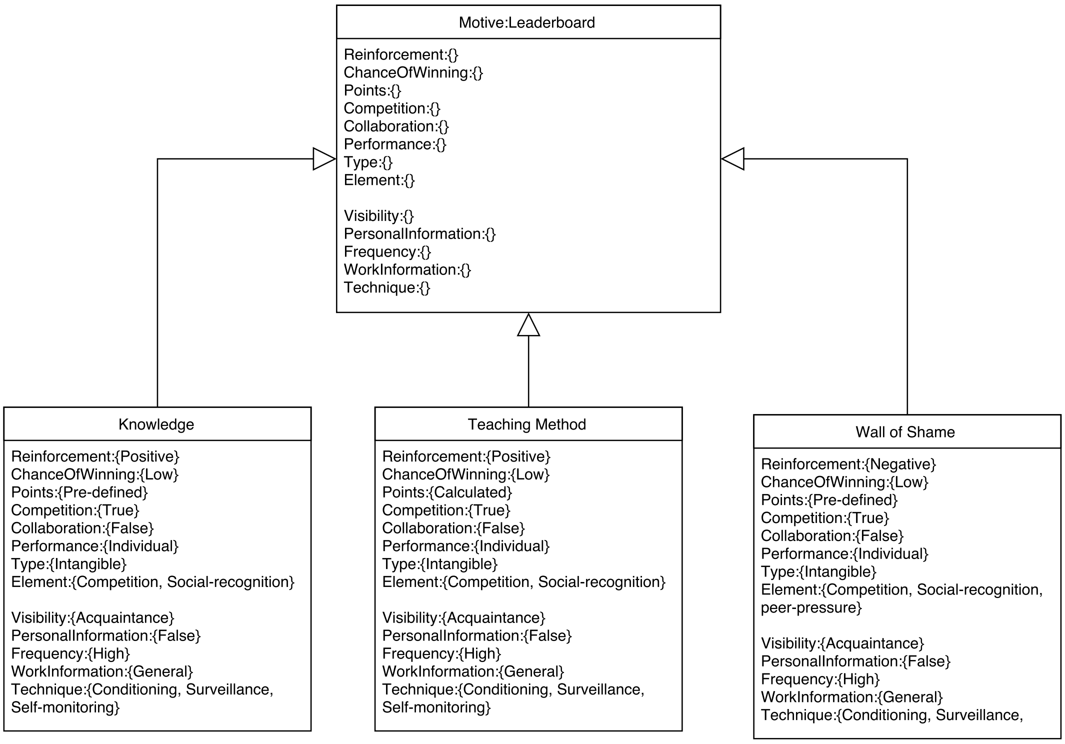


Fig. 8.12 Digital motivation designed in the DMML session – Leaderboards as motives

DMML Model and Design Managers provided positive feedback to the additional constituents and their attributes that DMML introduces in comparison to the $i*$ framework, believing that these additions will make the models more effective. DMML was perceived to be more flexible regarding defining the behaviour of each motive, allowing them to understand the settings of motives in details. Also, the attributes added to the tasks were regarded positively by the managers. However, they did not agree with all assigned values of those attributes. They believed that some of the values were not correct and the values for the attributes should be decided by the "Quality department" of the organisation, and not the software analysts and designers. The reason behind this was the complexity of the tasks and lack of a comprehensive understanding of the software system analysts with regards to these tasks. It was denoted that the *marking* task is not a quality task and the managers disagreed with this assignment. Nevertheless, having attributes were "helpful" in deciding whether a motive is suitable for the intended task if the values were set

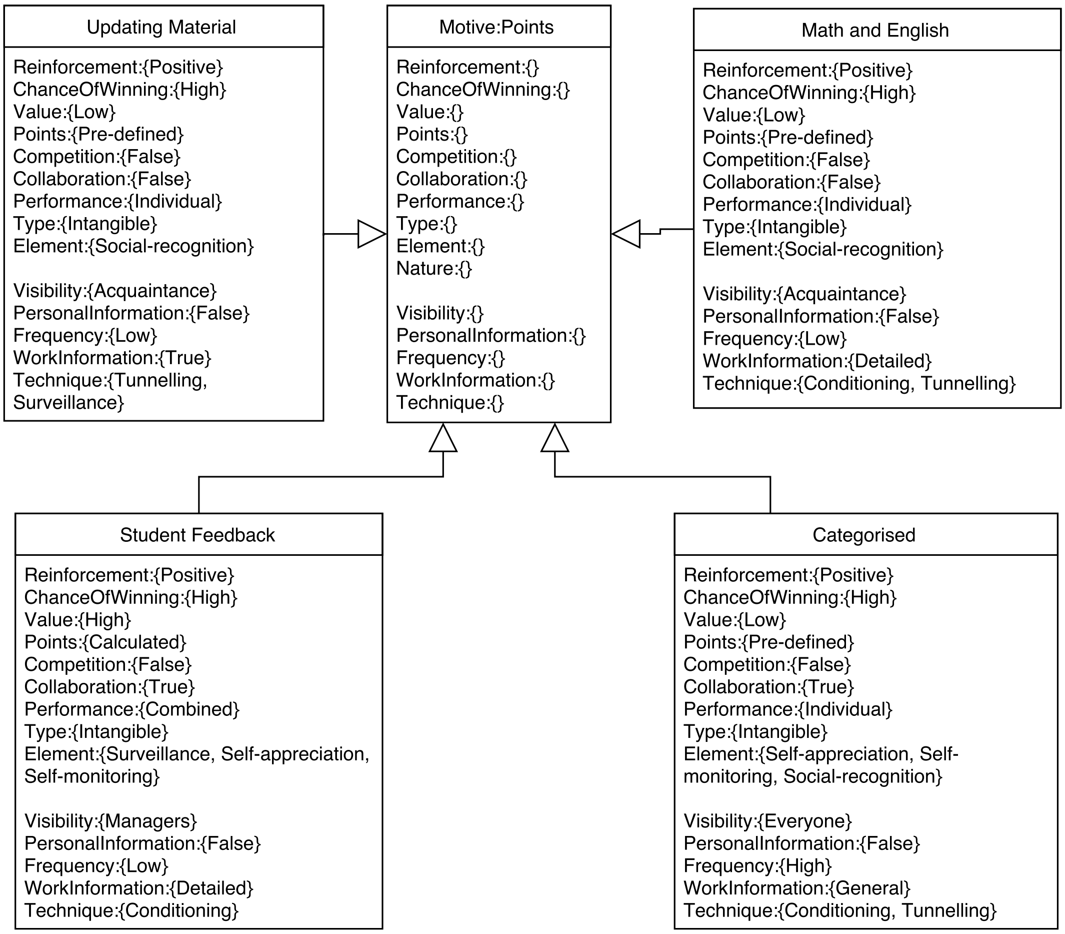


Fig. 8.13 Digital motivation designed in the DMML session – Points as motives

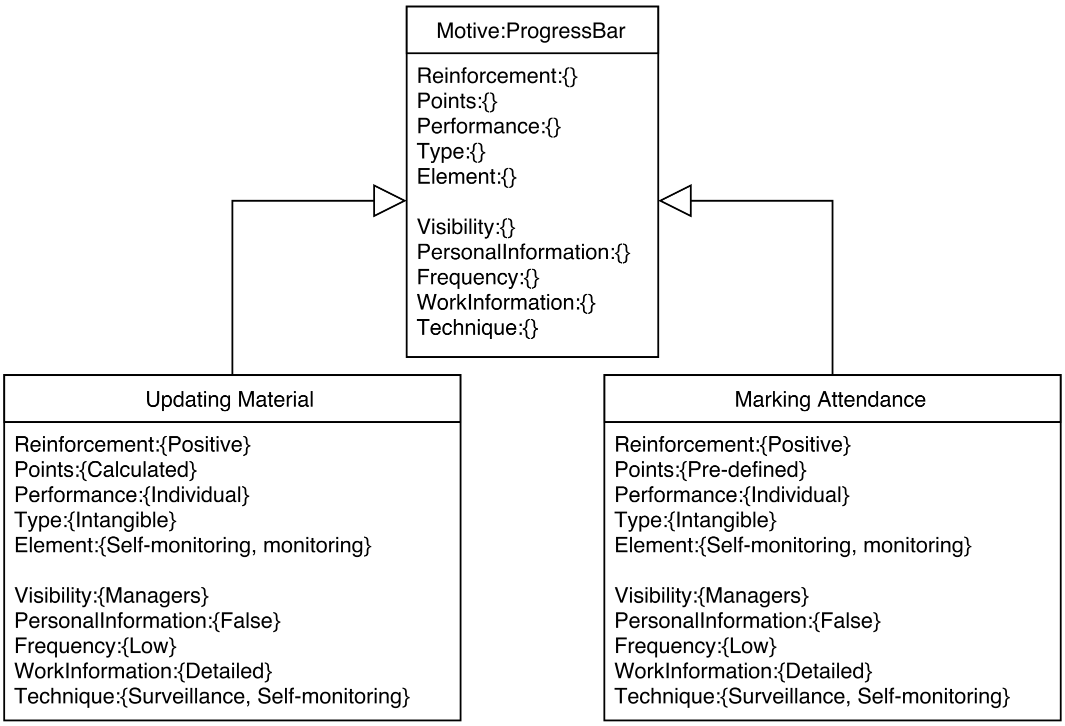


Fig. 8.14 Digital motivation designed in the DMML session – Progress-bar as motives

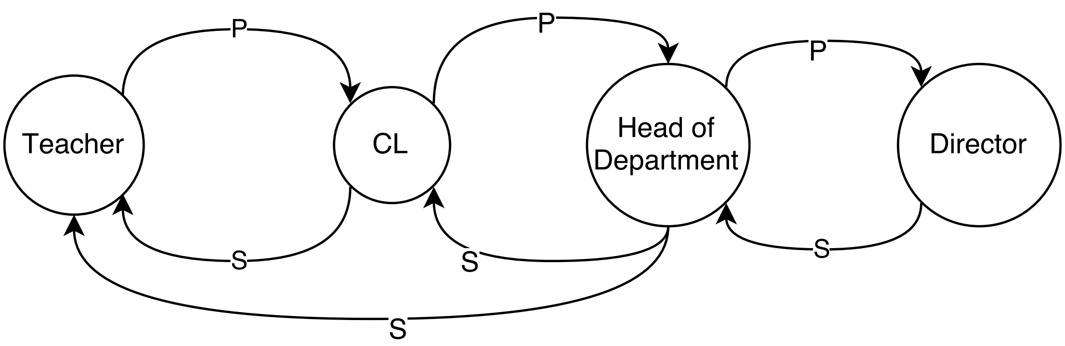


Fig. 8.15 Digital motivation designed in the DMML session – Actors relation

correctly. For instance, the managers agreed on adding a badge for the marking task. The reason for this decision was made based on the information which was available on the model, declaring that a badge will promote collaboration and not competition. Since marking is quality based, competition is “best to be avoided”. However, there was a unanimous disagreement on the *wall of shame* leaderboard as it had negative reinforcement, stating that “marking is a very important part of every teacher’s job here, we want everyone to do this properly, no additional pressure is required. We do not want to persuade the teachers to just mark for the sake of not appearing in the leaderboard and avoiding the penalty. It will create a lot of unfairness to some students.”

Also, it was mentioned that the relations mapping of the DMML provides usefull information, helping in making decisions with regards to the suitability of a motive for a task. It is not advised to involve two ’roles’ in a similar “scoreboard” if there is a hierarchy between the two. Also, another issue that the managers mentioned was that two roles should not be involved in a rewarding mechanism if one of the roles can make decisions with regards to the rewards. These two issues were the case for the leaderboard which was designed for increasing the knowledge, and the reward assigned for learning and embedding math in lessons. This issue with the design was detected using the mapping between the agents and the roles, enabling the detection of the same agent playing various roles. Which in this case, was the head of the department role and the teacher role. One flaw with the modelling language that was detected by one of the managers was that although the modelling language clarifies how the points are calculated, it does not provide the role responsible for calculating the points, in case the points are not pre-defined. Defining the person in charge of this calculation helps to identify whether an agent is involved in the motive as well as responsible for assigning points to other agents. It was added that this is very easy to happen as educational organisations have numerous tasks which are shared amongst all staff, regardless of their role. Therefore, the presence of these mappings can help detecting and preventing settings which may cause these issues.

It was also mentioned that the use of personas would be very beneficial as the settings are very diverse, different staff may have conflicting preferences. The use of personas can help in finding the most common settings and reduce the possibility of the conflicts. The managers found the visibility attribute of the motives to be interesting, as this was deemed to be a critical aspect of integrating DM in a BIS.

Verdict In general, the managers found the model created by DMML to be more expressive, flexible, effective, usefull, and scalable for designing and modelling DM. DMML provided more details and allowed in-depth understanding of the designs. It provided with a possibility of focusing on a specific area of the organisation and deciding for that specific area. It provided with usefull relations and information which allowed more discussions, with regards to various ways which could enhance the design of the DM. It had clear characteristics and attributes which enabled a better understanding of the behaviour of the DM and allowed for better analysis and decision making. All these features of the DMML made it the choice of the managers for analysis purposes and decision making. However, the *i** modelling framework was in the interest of the managers as well. Although the design of the DM from the GORE focus group was not very appealing to the managers, it was stated that the use of this could be a useful tool for presenting purposes. DMML could be very large and provide much information which may not be of interest of the senior management team. DMML could be used as the design tool and enable very detailed information, and the *i** modelling framework could provide a higher abstract level of the design, provided with a more general information about the design of the DM.

In the end, the managers have decided to study the design of the DM from the DMML focus group in more details and enhance it. The enhanced design will be presented to the senior management team of the organisation for their approval. There have been a number of issues with the design which should be fixed prior to implementation. A number of tasks were given incorrect values for their quality orientation, unifor, or measure-ability. Also, some dependency relations were missing as a result of not considering the learners as a part of the system. It was mentioned that although students are not part of the business side of the system, however, there are some dependency relations which require them to be a part of the system. such as submitting their assignments for the marking task.

8.2.4 Chapter Summary

This chapter evaluated Digital Motivation Modelling Language in two separate studies. The evaluation of DMML focused on its effectiveness and usefulness, as well as the learn-ability of the language specifically for novice software analysts. Goal modelling was used as a benchmark and for comparison purposes. In this chapter DMML illustrated positive potential for helping requirements engineer in the modelling and analysis of motivation requirements and in particular its digital form in business information systems. Despite positive advantages that DMML has shown over goal modelling frameworks, in particular the *i** framework, this chapter did not reject the usefulness and effectiveness of goal modelling, but advocates its suitability for a more abstract and holistic designs of digital motivation in business information systems. In the next chapter, this thesis will be concluded and future work, where applicable, will be presented.

Table 8.5 GORE VS. DMML - weaknesses and strengths for engineering motivation

	Strength	Weakness	Argument
GORE	• Concrete and easy to identify constituents • Good level of abstraction • Good modelling of organisational structure • Convenient notation • Condensed • Easy to learn	• Does not consider instance level relations • Lacks detailed DM constituents • Lacks DM relations • Will require large documentation if used to design DM • Does not enable detailed analysis for DM • Does not enable automated analysis for DM • Does not consider the end-users	Goal modelling provides a good level of abstraction for modelling a software system which is useful for concretising the model and providing a holistic idea of the software system. Although it lacks DM specific constituents and relations, it can still be beneficial in the early design processes of DM for a BIS.
DMML	• Detailed DM constituents • Several DM relations • Expressive in terms of DM • Considers instance level relations • More detailed constituents of the environment • User-centred • Enables detailed analysis for DM • Enables automated analysis for DM	• More difficult to identify constituents, especially the task attributes • Creates large models which may be hard to analyse by humans • Requires more time for modelling • Requires more learning load	Despite DMML being more difficult to use in comparison to goal modelling, it is still beneficial to use. DMML is more expressive in terms of DM, considers the preferences of the end-users via personas, provides DM specific constituents and relations, considers instance level context. DMML can be used as a guideline for DM designers for motivation requirements elicitation and its mathematical formal specification allows the design and implementation of automated analysis tools which can detect issues with a given design or suggest possible suitable designs for a given environment

Chapter 9

Conclusion and Future Work

It is in the interest of BISs to satisfy the motivation requirements of their employees as this can lead to the satisfaction of other quality requirements such as an increase in production or increase in quality of work. Currently, motivation in its digital form is widely introduced to BIS with the intention of increasing the staff's motivation and engagement with work.

Enterprises embed various motivational strategies as part of their management routines. These strategies include appraisals and bonuses offered to encourage employees to perform their tasks more efficiently and boost their achievement of both business goals and quality outcomes. Motivation in its digital form (DM) has gained attention in the BISs and is implemented in different types. Despite the success of DM in enterprises, this research has argued that its design is still following approaches which are highly reliant on the creativity of the designers with limited engineering principles and life-cycles. DM is similar to classical motivational theories in several aspects. Nevertheless, its digital incarnation brings new characteristics and abilities to it, e.g., capturing data with higher frequency and granularity, that amongst other things enables more precision in employee performance monitoring, accuracy and transparency in the rewarding system.

In light of these new characteristics and abilities, this research argued that an ad-hoc design of DM for a BIS which does not consider the features mentioned above and abilities of DM, may be detrimental and pose adverse side effects, e.g., increasing the pressure and stress within the workplace. Hence, this thesis has conducted empirical and non-empirical studies to create a software engineering solution towards the design and implementation of DM in a BIS, considering the socio-technical system that DM is intended for and the additional characteristics and aspect that DM has in comparison to classical motivation theories.

As a result, this thesis proposed Digital Motivation Modelling Language (DMML); a modelling language specialised in capturing DM requirements and its relations to other elements of the business environment. DMML allows the elicitation of motivation requirements and produces the motivation model. The model can be augmented with a set of automated reasoning to detect various conflicts and issues a DM can introduce to a BIS.

To conclude this thesis, a summary of the thesis contributions to the knowledge is presented in Section 9.2, followed by research challenges, as well as possible future works.

9.1 Research Question and Objectives Revisited

As outlined in the introduction chapter of this thesis, this study aimed at investigating "*How can motivational requirements be modelled in a business information system, how can they be analysed based on the capabilities of the model, so that such an analysis illustrates the effects of digital motivation on the business information system, and how can motivation requirements life-cycle be systematically adapted considering the vigorous social aspect of digital motivation?*"

To achieve this aim, four research objectives were developed:

- **RO1:** Background research/literature review and identify the gaps in the literature
- **RO2:** Develop a method to enable a systematic approach towards implementing digital motivation
- **RO3:** To develop an automated analysis mechanisms which enable the processing of digital motivation and detect shortcomings and inconsistencies in the design
- **RO4:** Evaluate the modelling and analysis framework for Digital Motivation

Sections 9.1.1, 9.1.2, 9.1.3, and 9.1.4 present how each of these four objectives were satisfied.

9.1.1 Objective 1

To address the objective 1 of this research, a literature review on motivation and DM was conducted. In addition to the literature review, interviews and surveys were performed involving domain expert with academic and industrial background, as well as managers and employees with the experience of working with DM. The initial studies of this research reveal that DM is still in its infancy and there are still debates and ambiguities with regards to various aspects of it. These debates and ambiguities revolve around the definition of DM, the stakeholders who need to be involved in the design processes, ethical issues that it may introduce, its best practices, and engineering approaches.

9.1.2 Objective 2

To achieve the objective 2 of this research, a further analysis on the findings of the objective 1 of this research was conducted, followed by further empirical studies.

The investigation in this objective aimed at conceptualising DM and derive the constituents and relations that shape DM. During the investigation, it was noted that DM to a great extend relies on the perception of its end-users and they should be involved during the design phase of DM. As a result, this research advocates the use of archetypes and personas in the early design stages and proposed a set of guidelines which can help designers to elicit the motivation requirements of end-users and achieve a level of understanding of what the end-users expect from DM.

The constituents and the relations were used to create a modelling language, digital motivation modelling language (DMML), which is formally specified using set theory in mathematics that allows modelling and computational analysis of DM. To allow a human readable and understandable model, graphical notations were developed for DMML. DMML divides DM into two parts, the Environment it is applied, and the Motives it is introducing. DMML allows the modelling of DM at abstract level and instance level, allowing a thorough analysis of the context and impacts DM may have on the intended environment. Moreover, reasoning algorithms were developed which can aid in detecting various conflicts and issues that the introduction of DM can present to the environment. The algorithm analyses the environmental attributes, relations, and the settings of motives, as well as instance level data and results in the issues and conflicts which may arise using DM in the given setting.

9.1.3 Objective 3

To address the objective 3 of this research, an initial version of an expert system was created following Object Oriented Programming approach, using Java 8 programming language. The tool takes the attributes with regards to the environment and motives, and the available relations between the constituents, and facilitates the developed reasoning algorithms to automatically detect issues with the given setting of DM and the environment. The object oriented approach used in the tool allows for a convenient extensibility and scalability.

9.1.4 Objective 4

To evaluate the modelling language, a two phase evaluation study was conducted. First, a set of novice system analysts were invited to take part and use DMML to model fictional scenarios. The aim of this stage was to figure out the ease of use and learnability of DMML, its expressiveness, its efficiency, and whether participants have the intention to use this in their own projects. Second, managers of a BIS were invited for interview sessions with the purpose of requirements elicitation. The requirements were given to expert system analysts to design a DM using goal modelling and DMML. This stage aimed at the usefulness and effectiveness of DMML in comparison to goal modelling. The results of the evaluation reveals that DMML is effective and useful for the design of DM in a BIS. However, the use of goal model was not rejected and it deemed to be a useful and effective tool for modelling DM at a higher abstract level, providing a baseline for DMML.

9.2 Thesis Contributions

This thesis has contributed to the knowledge of the engineering of motivation. In the following, three main contributions of this thesis will be presented.

9.2.1 A User-centred Design Approach Towards the Design of Digital Motivation: Archetypes

The first main contribution of this thesis is the development and construction of a user-centred design approach for DM that is the guidelines for the creation of archetypes and personas (See chapter 6). The approach was constructed based on an extensive literature review and several empirical studies, with experts in the field of DM and stakeholders, e.g., employees, managers, and non-empirical studies. The approach targets the end-users in a BIS context, allowing the designers to gain a better understanding of their end-users, leading to a closer design to the preferences of the end-users. As discussed, it is far from reality to enable a design of DM which can satisfy the needs and preferences of every individual involved. Nevertheless, the use of personas and archetypes allow a closer design, satisfying a larger proportion of needs and requirements of the users.

Creation of personas allows the DM designers to have a better understanding of the actual end-users, providing a communication channel between them. Since personas are given fictional human-related attributes, e.g., age, job, gender, and avatar, designers can connect better to the personas as individuals. This connection allows the designers to gain a better understanding of how to provide a DM design which satisfies their requirements, and in the case of conflict in the requirements, how to duly resolve the dispute.

9.2.2 A Modelling Language for Motivation Requirements in Business Information Systems

The second main contribution of this thesis is a modelling language for motivation requirements, called DMML (See Chapter 7). This modelling language augments the *i** modelling framework as it provides a proper set of concepts which are necessary to model motivation requirements, e.g., goals, tasks, and actors, and the relations between these constituents.

DMML is defined mathematically to maintain rigour and consensus, and it benefits from graphical notation, UML-like class diagram, and textual representation. Graphical notation provides an abstract modelling of the design, which showcases the constituents, and their relations in the final design of DM. The UML-like class diagram is designated to represent the motives being added to the BIS in details, specifying their attributes and behaviours. Finally, the textual representation provides instance level characteristics and attributes of the BIS, providing with the relations and characteristics of instances in the BIS.

9.2.3 An Expert System for Automated Analysis of Motivation Requirements

The third main contribution of this thesis is an automated analysis tool which utilises DMML and uses the environmental relations and attributes, and the design of the motives with detailed settings as an input and results in the suitability of the design with the given environment. The tool uses the algorithms provided to it as a mean for detecting issues and analysing the given BIS with the design of the DM. The tool is based on object-oriented programming to enable scalability and flexibility for future additions or alterations to the modelling language, addition of new algorithms, or amendments of current algorithms.

9.3 Research Challenges

This research has tried to provide an engineering approach for the design of DM in a business information system. During the studies, a number of solutions have been identified, with some of them being addressed and some others remaining as challenges to be addressed in future works.

It was discussed in this thesis that motivation in its digital form adds attributes and characteristics which yield the need for new considerations once it is being used. In addition, the nature of a business information system is different from other uses of DM such as marketing with the aim of increasing motivation. The use of DM in a BIS is more coercive than the field of marketing. In a BIS, employees may not be able to opt-out of DM even if they are provided with the choice, for various contextual reasons. Whereas, this is not the case for many other areas of uses of DM, such as health-care where users may choose to stop using DM at any point without facing any consequences from the organisation running the DM system.

As a result, DM is a more sensitive topic in a BIS, requiring a careful design with detailed consideration of its end-users' needs and requirements. This thesis has advocated the use of personas to enable a close consideration of end-users' motivation requirements in the design phase of DM development and implementation. Facilitating personas aids software designers to have an understanding of who the end-users are and which settings of DM could be used and which settings are better to be avoided. However, motivation level of people depends on various contextual elements and also humans' psychology, which means people may experience changes in their preferences of the settings of DM. To address this issue and provide a sustainable motivation through DM, the design should consider evolutionary techniques to detect contextual or psychological changes and adapt accordingly. The evolution of a DM design demands constant checking of the satisfaction level of the employees with the implemented DM system. Another issue is the dynamicity of BISs themselves. BISs evolve over the course of time, from various perspectives, e.g., the hiring of new employees, changes in the policies, and the emergence of new technological advances. These changes may have an impact on the fitness of the DM for the BIS, which in turn requires constant monitoring of the current system and detecting the need for a change in the design of DM. A solution to this problem could be the use of social sensing (Ali et al., 2011) and social adaptation (Ali et al., 2012), which provide solutions to use humans as the monitoring mechanism and change the software system based on their feedback.

Another challenge in the design of DM is the diversity of DM designs and multiplicity of end-users' opinions on those designs. This abundance of the requirements and preferences may not be seen as a hard to resolve challenge as long as the preferences are not conflicting. Nevertheless, once there is a conflict in the preferences, the dispute is not easy to resolve. Although the user-centred design approach proposed in this thesis tries to tackle this issue, nonetheless personas help in creating a closer design to the preferences of the users and a unanimously completely accepted design is not achievable through the facilitation of personas. At the current state, designers need to compromises to find a balanced design which is not necessarily going to satisfy all the motivational needs and requirements but can fulfil this to an acceptable extent for a considerable number of end-users.

9.4 Areas of Use

This thesis has based its arguments on goal-oriented requirements engineering. However, the concepts and relations used in the modelling language constructed in this research are not limited to goal-oriented requirements engineering, and are valid and re-usable in other areas of computer science and software engineering. In addition to the concepts and relations which were constructed in the modelling language, the algorithms proposed for motivational requirements analysis can inform the field of computational behavioural change models, organisational management, and work ergonomics.

9.5 Threats to Validity

This section outlines the measures taken to improve the reliability and validity of this research during.

9.5.1 Reliability

Reliability of a research presents the likelihood of generating the same results once the same methodology and measures are followed by other independent researchers.

It is noteworthy that studies which involve humans are susceptible to unreliable and inconsistent results as humans may have varying answers for the same question. However, there exit measures which limit the unreliability and inconsistency, such as test-retest reliability measure and inter-observer reliability measure. This research has used the inter-observer reliability measure and a semi test-retest reliability measure to limit the unreliability and inconsistency in the results of the study. All qualitative results of this study were content analysed using two researchers separately, and once a disagreement occurred, a third researcher was involved to help reaching an agreement. In addition, findings of the empirical studies were confirmed using another confirmatory study to ensure the reliability of the findings.

9.5.2 Validity

Validity of a research presents how well a research is measuring what it is aiming to measure. The measures taken to limit the threats to the validity of this research are described as follows.

Construct Validity

Construct validity is concerned with the measurement of the construct the research is intending to investigate. There are several threats which can invalidate the construct validity of a research, such as researcher bias, mono-operation bias, mono-method bias, or inadequate pre-operational explication of constructs. Pilot studies have been used to detect issues with the study designs and make adjustments prior to the actual investigation. This research has used two groups of system analysts with varying levels of expertise to eliminate the mono-operational bias. Furthermore, to address the issue of mono-method bias, this research has used various sources of information such as documents analysis, interviews, surveys, focus groups, and lab sessions. In addition, the study designs have gone under expert reviews for detection of the issues, enhancements, and improvements to provide the research with adequate pre-operational explication of constructs.

Internal Validity

Internal validity is concerned with whether the results of a study are actually caused by the intervention or other confounding factors. This research has taken a number of measures to limit the threats to its internal validity. In the evaluation studies where comparisons were made, all the participants were assigned to groups randomly by ordering them based on their surnames. Next, the variance in their expertise and knowledge in the expected area was kept at a low level by inviting people with the same background and level of expertise in the area of study. Expert survey study was performed on an invitation only basis to ensure the relevance of the participants to the purpose of the study. The affiliation of the majority of the participants were academic, however, they have implemented DM as case studies or academic projects, which provided them with experience on its implementation. In addition, to prevent the learning effect on the results, the expert system analysts were divided into two separate groups, control group performing the goal modelling task and test group performing the DMML modelling task. In addition, academic literature, document analysis, and expert studies were used for triangulated data collection, as well as research method triangulation via pilot studies, interviews, focus groups, and lab sessions.

External Validity

External validity is concerned with the generalisability of the results of a study to a wider domain. To address the concerns of the external validity, this study has involved experts from several affiliations and locations, and ensuring that the experts in the interview sessions did not have any work in common to increase the diversity of opinions. In addition, a diverse sample in terms of gender and age has been used in various stages of this research to produce a more generalisable results.

Despite these measures, a number of threats to external validity exist for this research. Qualitative research is mostly difficult to generalise as the sample population does not cover adequate diversity in locations, gender, age, and other contextual elements such as job or familiarity with the area of study. The evaluation of this research has been conducted involving participants from south west of the UK and a business information system in the south of the UK. In addition to the limitation of the location, lack of resources limited the study in the number of participants to small groups. In addition, the evaluation phase of this study involved only one large organisation. These limitations make the generalisation of DMML difficult and yield the need for further investigations. These investigations need to be conducted with a wider sample population and in various other organisations in several locations to produce enough data and information for generalisation purposes.

Another threat to validity of this research was the use of likert scale in the survey expert study. Providing the agree and disagree as answers to the questions is subjective to humans understanding and judgement of agreement and disagreement and not always human have a clear and crisp answer to these questions. This research has used open-ended questions and provided a comment box for the participants which allowed them to clarify their answers when they did not have a crisp answer as agree or disagree to the questions and allowed them to elaborate on what their actual answer is. The comments provided by the participants were later content analysed and were reflected as the results of the study phase.

In addition, another threat to validity of this research is the emphasis on gamification in the early stages of this research. This emphasis was due to the fact that gamification is well known amongst the experts in the field and could be used as a common ground for collecting the opinions of participants. Despite the heavy emphasis on gamification, the questions and the studies were designed to cover digital motivation as a whole and result in generalisable findings.

The final identified threat to validity of this research relates to the interview sessions with the managers of the BIS for the evaluation study. Due to organisational policies, voice recordings were prohibited in the premises and the only means for collecting the data was note taking, and only one researcher was involved in this phase of the study. This limitation can make the results susceptible to researchers bias and personal judgement. To reduce the threats and limitations posed to the research due to this limitation, all the notes taken during the interview sessions with the managers were provided to the participants for their approval and confirmation on the authenticity of the notes.

9.6 Future Work

The engineering of motivation requirements using DMML provides a methodological and systematic approach towards the design and integration of DM in a BIS. This systematic approach enables in-depth investigation of the BIS and allows a fitter design of DM. However, the constructed modelling language and systematic approach is far from complete and requires advancements which were left to be addressed beyond the scope of this thesis and as future contributions which will be discussed as follows.

One important possible future work is the full evaluation of the modelling language within an actual scenario using its full features and abilities. The current evaluations performed in this thesis were focused on the abstract level due to limited resources. As a possible future work, the language can be evaluated using its full features to allow the declaration that DMML is fully functional, helpful, useful, and effective in the context of BIS.

Furthermore, new algorithms can be identified and added to enable more diverse detection of issues and allow their resolution prior to the final design of the DM in BISs. The addition of these algorithms can enhance the abilities of DM and enable the DM designers to satisfy the requirements of the stakeholders better.

Another future work is the production of resolution policies to not only enable the DM designers with the detection of issues using DMML but also allow them to choose between solutions for the given issues.

Moreover, the Java tool implemented for DMML can benefit from a better interactive interface, allowing the manipulation of algorithms, the addition of algorithms, and the addition of constituents with minimum effort and no required knowledge of programming languages.

Also, an intelligent engine could be added to the Java tool to enable the tool to learn the environment over the course of time and make decisions autonomously. The tool can benefit from a centralised database which shares the knowledge amongst all available agents to enhance the knowledge-base and allow for better decision making and resolution of the future issues.

Last but not least, the evolution of the DM design over the course of time needs to be tackled in the future to allow a convenient systematic solution to detect the need for a change before users have lost interest in the design to prevent losses.

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Appendix A

Chapter 4 Appendixes

Expert Interview Questions

1. Could you please tell me some details about you?
   - For how long have you been working on Gamification?
   - Was it in industry, academia, or mixed?
   - Have you worked on the foundations and engineering principles for Gamification?
   - Have you implemented and applied Gamification in practice?
2. In the literature, there is a great deal of debate on the meaning of Gamification. How do you define Gamification? What are the core and primitive constructs of Gamification and what are those optional or secondary constructs? How do you differentiate Gamfication from related concepts such as Serious Games and Games with Purpose?
3. Gamification is seen a multidisciplinary field. The correct development of Gamification could require a joint effort between various fields of study. In your opinion, what are those fields?
4. Who are the stakeholders in Gamification development? In other words, who should be involved in the development process?
5. What are the benefits of Gamification and when/where do you recommend to use it?
6. What is the downside of Gamification and what are the issues to consider when adopting it and trade-off to consider, if any?
7. Having reviewed the literature, it seems to us that developing Gamficiation is still heavily reliant on the creativity of developers and researchers. Are you aware of any systematic approaches on how to develop Gamification? In other

words, are you aware of any rigorous methods for Gamficiation development, for example, on how to do the analysis, design, implementation and validation?

8. Gamification could be seen as a trick to get from people what they were not originally willing to give. For example, it may exploit human tendency to completion in order to attract users to do tasks not necessarily because they were genuinely interested in them. Do you think that Gamification raises any ethical issues? Are there ethical principles which we should be careful about when implementing Gamification?

9. What are the metrics to consider when evaluating the feasibility, the success and failure of Gamification?

10. Do you have any remarkable observations on the design of Gamfication such as the suitability of certain Game elements to certain types of tasks and users, the compatibility between certain game elements, trade-off between information quality and game elements used?

Survey Questions

Bournemouth University

This is an expert survey on Gamification. Gamification is an emerging paradigm to increase users' motivation and engagement. The questionnaire should take around 15 minutes to answer. It may take more time if you like to add your valuable comments. This survey will be used for research purpose only. You name and the name of your affiliation will not appear in any published work without your permission. There will be a £7.00 Amazon voucher available for anyone who has been invited and completes this survey successfully. Please provide your name and email address if you would like to receive the voucher and also if you would like to be sent the results. You can withdraw your answers from this research whenever you want by contacting us via the given email address.

The survey is prepared by:

Alimohammad Shahri ashahri@bournemouth.ac.uk

Survey Questions

Definitions: Task: A piece of work a user is committed to and would like to do. E.g. answering calls in a call centre, solving a quiz in e-learning, etc. Management: The person or the group managing the business and taking strategic decisions. Behavioural Economics: The study of the effects of social, cognitive, and emotional factors on the economic decisions and the consequences for market prices, returns, and the resource allocation.

Q1. How do you classify your expertise in Gamification?
- Academic Expertise (1)
- Industrial Expertise (2)
- Both (3)

Q2. What is your area(s) of expertise in Gamification?

Q3. How long have you had this experience (in years)?

Q4. How do you classify your expertise in Gamifiation?
- Expert (1)
- High (2)
- Medium (3)
- Low (4)
- None (5)

Survey Questions

Q5. To reach a definition of gamification and its difference from other related concepts, we would like to have your opinion on the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. Gamification will convert a task to a game	❍	❍	❍	❍	❍
2. Gamification is meant to achieve a certain users' behaviour when doing certain tasks, e.g. more engagement and motivation	❍	❍	❍	❍	❍
3. Gamification is not standalone and it should be always designed to work in conjunction with certain task(s)	❍	❍	❍	❍	❍
4. Gamification could be applied on tasks which are being used already (not before or in parallel)	❍	❍	❍	❍	❍
5. Gamification has its own added value, i.e. it is a part of user value creation at work, not only those related to behaviour change when performing specific	❍	❍	❍	❍	❍
6. The main goal of gamification is to increase motivation	❍	❍	❍	❍	❍
7. Gamification must lead to enjoyment	❍	❍	❍	❍	❍
8. Serious games and games with purpose are games by nature	❍	❍	❍	❍	❍
9. Serious games and games with purpose can be considered a kind of gamification (when you make the task as a game, then you gamify the task)	❍	❍	❍	❍	❍
10. Gamification is not a game	❍	❍	❍	❍	❍

Comments?

Survey Questions

Q6. Which fields of study should be involved in the development process of gamification?

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. User Experience: e.g. to understand users' behaviour towards the business and tasks and also game mechanics	❍	❍	❍	❍	❍
2. HCI: e.g. gamification requires careful, sometimes novel, design of Human Computer Interaction	❍	❍	❍	❍	❍
3. Psychology: e.g. for motivation and engagement, and also deciding when a task or a gamification technique becomes boring	❍	❍	❍	❍	❍
4. Game Design: game mechanics come originally from Gaming. Expertise in Game Design is thus needed, e.g. game rules and reward mechanisms	❍	❍	❍	❍	❍
5. Management and Human Resources: e.g. gamification could have an impact on the performance and the social relationship between employees (users)	❍	❍	❍	❍	❍
6. Behavioural Economics: e.g. whether competition and leader board would increase the performance and quality of doing a certain task for certain group of users	❍	❍	❍	❍	❍
7. Software Engineering: e.g. to systematically construct gamification from requirements, to design, to implementation and testing	❍	❍	❍	❍	❍

Comments?

Survey Questions

Q7. When designing gamification, whom of the following would you typically consider a stakeholder or consultant?

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. Strategy makers and management: E.g., gamification may lead to changes of behaviour and thus affect the organization social structure (when using leader boards, reputation, etc.)	❍	❍	❍	❍	❍
2. Legal department: e.g. collected points indicates whether the employee is doing the work. Can be that used by managers when deciding to promote an employee?	❍	❍	❍	❍	❍
3. Security and privacy engineers: e.g. listing the top 10 in leader boards, means others are not in the top 10. Points reflect a person performance.	❍	❍	❍	❍	❍
4. End-users: e.g. for testing and validation and feasibility study	❍	❍	❍	❍	❍
5. Behavioural economic experts: e.g. for gamification design which is informed by the effect of social and psychological aspects on business objectives	❍	❍	❍	❍	❍
6. IT developers: for managing the development and maintenance of information technology e.g. real time communication, video server, communication channels	❍	❍	❍	❍	❍
7. Researchers: e.g. research is needed in most gamification projects as we still do not have ready-to-use solutions or templates for such an emerging field	❍	❍	❍	❍	❍
8. Domain experts: e.g. experts in the business being gamified will inform the design of correct gamification	❍	❍	❍	❍	❍

Comments?

Survey Questions

Q8. This question is to get your opinion on when gamification should be used and if there are any preconditions for that use.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. Theoretically, gamification can address any task, any user and enterprise. This does not mean it is easy to implement correctly, but the idea itself has no restrictions	❍	❍	❍	❍	❍
2. Gamification requires that there is a need for something else, e.g. behaviour change. Gamification by itself is not an objective	❍	❍	❍	❍	❍
3. Gamification requires that the users' characteristics, enterprise, and context of the use are known very well, Gamification is not “one size fits all”	❍	❍	❍	❍	❍
4. Gamification is not a cheap solution from both technical and organizational perspectives. It should be used to support long-term goals and also when users/employees loyalty is a key	❍	❍	❍	❍	❍
5. Gamification requires that we have clear business objectives and metrics to measure success and failure. This is preliminary to decide the suitability and feasibility of gamification	❍	❍	❍	❍	❍

Comments?

Survey Questions

Almost done.... next page will be the last one ... Q9. This question is to get your opinion on the concerns to consider when developing Gamification.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. Gamification should not be used when there is doubt about users perception of gamification, e.g. certain users see gamification as trivialization of their job	❍	❍	❍	❍	❍
2. It should not be used when it could change management style against the company norms. e.g. transparency about who has the highest performance would affect the way promotions are given by managers	❍	❍	❍	❍	❍
3. Users should not feel they are forced to use gamification as this will lead to negative impact on the enterprise and the well-being at work	❍	❍	❍	❍	❍
4. Gamification should not lead to undermining the task. Users should not forget that gamification is for making the task more interesting, but it is still their job to the task	❍	❍	❍	❍	❍
5. It is hard to guarantee that every user will see gamification positively regardless of how testing and validation were conducted. It is highly personal	❍	❍	❍	❍	❍
6. Not all game mechanics are applicable for any kind of tasks, e.g. leader boards might not be suitable for the task of a collaborative editing a shared document	❍	❍	❍	❍	❍
7. The desire to win the reward may affect the quality of the work negatively, e.g. users may do tasks in a cursory manner to collect points and win	❍	❍	❍	❍	❍
8. A game mechanic has a lifetime. That is, users might get	❍	❍	❍	❍	❍

Survey Questions

disinterested with it and reject it after a while					
9. Gamification may lead to clustering users and changing the original structure of the organization, e.g. good students could group together to win all the t-shirts given as a reward in Gamified learning	❍	❍	❍	❍	❍
10. Not all game elements can be applied together, e.g. using competitive and collaborative elements together might not be a good idea	❍	❍	❍	❍	❍
11. Rewards are not good for intrinsically and already motivated users. If you remove the reward after a while, the intrinsic motivation goes with it	❍	❍	❍	❍	❍
12. Rewards are good for tasks which are not creative or intellectual. Rewards could distract users from applying their mind on the task.	❍	❍	❍	❍	❍

Comments?

Survey Questions

Q10. This question is to investigate whether there are systematic approaches to develop gamification. We would like to take your opinion on the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. There is not any established systematic/rigorous approach available in the literature	❍	❍	❍	❍	❍
2. There are guidelines on certain facets of gamification. Guidelines are a looser form of systematic approaches	❍	❍	❍	❍	❍
3. There is not necessarily a systematic approach to build gamification, it is a highly creative activity and systematic approaches could hinder success	❍	❍	❍	❍	❍
4. The engineering of gamification could be seen as a variation of user–centred design	❍	❍	❍	❍	❍
5. User–Centred Design is supportive but not enough for the engineering of gamification	❍	❍	❍	❍	❍
6. The engineering of gamification is not simply an assembly of other approaches, e.g., motivation theory, gaming, business analysis, etc. It has its own challenges and requires novel engineering approaches	❍	❍	❍	❍	❍
7. Business objectives should be considered from the start, i.e. gamification alignment with business objectives is core	❍	❍	❍	❍	❍
8. There is a lack of standard metrics and creteria for analysing the feasibility of gamification	❍	❍	❍	❍	❍
9. There is a lack of standard metrics and creteria for analysing the success of gamification	❍	❍	❍	❍	❍
10. There is no guarantee of the success of gamification	❍	❍	❍	❍	❍
11. There are tools to aid the design of gamification, e.g. tools offering templates and patterns and check-lists, but not rigorous approaches	❍	❍	❍	❍	❍

Survey Questions

12. It is a mistake to think of gamification as a piece of software to engineer. It is a technique to customise and apply in the first place	❍	❍	❍	❍	❍

Comments?

Survey Questions

This is the last page ... thanks for being patient with us Q11. It is argued that gamification could raise ethical issues. To explore this, we would like to know your opinion of the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. Gamification can lead to tension in the individuals/groups relations, e.g. when applying leader board	❍	❍	❍	❍	❍
2. Gamification can lead to exposure of information users are not necessarily willing to expose, e.g. saying who are the top performers	❍	❍	❍	❍	❍
3. Gamification can create tension in the person,. i.e. it can be looked as a monitoring system on how well a person is performing	❍	❍	❍	❍	❍
4. It could lead to rating people and creating classes, i.e. additional pressure on some people and change in the equity principles	❍	❍	❍	❍	❍
5. Gamification ethics are highly dependent on the norms and culture of the organisation	❍	❍	❍	❍	❍
6. Gamification capture a lot of personal data, e.g. about performance. Privacy policies and data protection need to be augmented by ethical awareness.	❍	❍	❍	❍	❍
7. The desire for “wining” could drive some users to overlook how data are gathered and to whom it is exposed. This makes some users, at times, vulnerable	❍	❍	❍	❍	❍
8. Ethics in gamification could be seen analogous to those in marketing, i.e. gamification could make some tasks attractive to users who would not ethically like to perform without gamification	❍	❍	❍	❍	❍
9. Gamification, in certain cases, could mean that trying to get from people more than what their job requires, i.e. using gamification as an exploit-ware	❍	❍	❍	❍	❍

Survey Questions

10. Ethics should be seen case by case and even at the individual users level, e.g. the same game mechanic for the same task may be seen differently from ethical perspective according to the user	❍	❍	❍	❍	❍
11. Freedom of Information. Users ability to see what is stored about them is an ethical issue	❍	❍	❍	❍	❍

Comments?

Survey Questions

Q12. We are looking at best-practice recomendations for developing gamification. To this end, we would like to know your opinion about the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
1. Gamification should focus on end-users. Adopting gamification without rich knowledge of users could turn to be harmful on users experience and consequently the business	❍	❍	❍	❍	❍
2. Age is a distinguished user attribute, e.g. elders might not like virtual rewards	❍	❍	❍	❍	❍
3. Gender is a distinguished user attribute, e.g., males may like competition, females may like cooperation	❍	❍	❍	❍	❍
4. Social background is a distinguished characteristic of users to consider, e.g. some cultures are reputation-oriented while some others are not	❍	❍	❍	❍	❍
5. Gamification should be informative, people like feedback on how they are doing	❍	❍	❍	❍	❍
6. Users should not feel they have to rely on gamification, i.e. they should be still able to do the task perfectly without gamification	❍	❍	❍	❍	❍
7. We cannot decide the applicability and efficiency of a game mechanic per se; amongst other aspects, an analysis of the task and users should be made	❍	❍	❍	❍	❍
8. Gamification should be configurable by managers, e.g. the tasks, the user group and the period to activate and deactivate	❍	❍	❍	❍	❍
9. Management and work style, hierarchical vs. non-hierarchical, needs to be considered, e.g. Leader boards may seem odd in highly collaborative teams	❍	❍	❍	❍	❍
10. The word Gamification might lead to a negative reaction by some	❍	❍	❍	❍	❍

Survey Questions

managers, e.g. trivializing the work. Words like Behaviour Change, Employee Engagement could be used interchangeably					
11. It is desirable that gamification is designed as an adaptive mechanism, e.g. depending on the type of users, the culture of the group, the business status, etc	❍	❍	❍	❍	❍

Comments?

Please add any comments you may have about the survey and the topic in general:

Please select all that apply

- ❑ I would like to receive the results of study? (1)
- ❑ I would like to be emailed with the 7£ Amazon Voucher details? (2)

FINALLY Please enter your email for future use (Sending you the Voucher, Sending you the results, Removing your answers if you wish later, etc)

Appendix B

Chapter 5 Appendixes

End User Interview Questions

Interview

Figure 1: Profile page with avatar, progress bar, badges, points, etc

End User Interview Questions

Figure 2: Leaderboard with information on other users

End User Interview Questions

Scenario

(Picture 1)

Imagine that in your workplace, you have a personal profile that shows your activities, achievements, to-do tasks, etc. In this personal profile, you can have your avatar, which shows your name and photo and maybe your status (e.g. busy, angry, late, happy, etc), and you can also see the list of things you have done, or you should do. For every task you do, you get some points, and for some specific tasks or after collecting certain points, you get badges. Also a progress bar shows how much of a task you have done and how much is left to do.

(Picture 2)

There is a leaderboard which ranks your colleagues by the points they have earned. This leaderboard shows top achievers amongst your colleagues. You can also see how much everyone has achieved by clicking on their names. This reveals their total points, their achievements, their badges, etc.

The whole point is that this system allows you to see how much you and other colleagues have progressed and achieved in your daily routines. It may also enable the managers and admins to see how much their staff have progressed and achieved. This process is part of what we call gamification, which is the use of game elements in daily tasks in order to motivate and entertain people at their workplace.

This study is focused on the effects of gamification design on work ethics. You will be asked questions based on a previous expert study on gamification and their opinions on the effects that gamification may have on a working environment. Please bear in mind that different employees with different performances and personalities may react differently. For example, while revealing an employee's status might be troublesome or even embarrassing for some (statuses like lazy or late), it may attract other employees and encourage them (statuses like busy or happy). The bottom line is that there are no right or wrong answers.

End User Interview Questions

- Would you please introduce yourself?
- How old are you, and where do you work?
- What is your job in your workplace?
- Have you heard about gamification before?

1. From the perspective of ethics at work, specifically from the tension perspective, how would an employee feel if the workplace implements gamification techniques like (i) a leaderboard which iteratively shows the list of top-performers (ii) employees getting badges in their profile reflecting their expertise level (it could go up and down depending on the recent performance) (iii) labels or avatar, reflecting the current status e.g. (active, inactive, busy, free, late, etc) (iv) a progress bar which shows to an employee, and perhaps other employees, the extent to which that employee has completed the task, e.g. the progress in handling new emails in customer services, the progress in handling a complex case, etc.? How would all these effect the tension and stress at work place in employees? (refer to picture 2).

2. Do you think there are negative and positive effects of these techniques on the relationship among team members and their perceptions of each other? In other words, do you think that these techniques could lead to a change in the attitude, interactions and collaborations among colleagues at the workplace? (refer to picture 2)

3. Certain gamification techniques (e.g. leaderboards, badges, points, progress bars and avatars) reveal a good deal of information about employees in their workplace. Such information could be visible to other colleagues and managers for different reasons. Examples: a progress bar of a colleague may indicate how busy he/she is. A status may reflect an employee's mood, something that an employee may or may not be willing to share with others. Points usually explain to colleagues how efficient an employee is, while that employee may or may not be willing to expose his points to other colleagues. Therefore, while gamification may aid efficiency and transparency at workplace, it may or may not be preferred by some employees. How do you view them from the angle of revealing information about your current activity, performance and status? Are there any preferences how such information should be revealed when gamification is applied? (refer to picture 1 and 2)

4. Gamification may be seen as a monitoring mechanism, which could cause some stress on the person. For example, it could be argued that the use of leaderboard, badges, points and progress bars may create some sort of stress on an employee to finish the work strictly on time and also to increase productivity. Some others may argue that this is fair and good as it reflects their outstanding achievements and would not cause any tension. Rather, it could be seen as a tension-relief system as it makes the job more entertaining. How do you think of the use of gamification from the perspective of acting as a monitoring system on employees at workplace?

End User Interview Questions

5. Information revealed through gamification may give profiles to people and create classes among colleagues. It could suggest that some people perform better than others in certain tasks, hence they get more badges, appear in leaderboards, have status and better representative avatars etc. Other techniques like progress bars would make it clear to others how fast a certain employee is in doing certain tasks. Since birds of the same feather flock together, all this may lead to employees with similar points or the same badges group together. How do you see that from the perspective of creating clusters of people, ranks and classes and affecting the interaction and collaboration among colleagues? As always, please let us know whether you think of positive and/or negative consequences.

6. As stated before, gamification can capture information about employees' productivity, status and achievements and even failures at the workplace. Similar to other sorts of data typically collected from employees (e.g. the regular appraisal) this could raise privacy concerns. Are there any particular observations of concerns related to the data collected from gamification? What would you accept or reject gathering and would you have any preferences or requirements on how this should be done and by whom it should be viewed and how?

7. Do you think it would affect the employees' attitude toward their tolerance of data collected about them when they have a high desire to get the reward, e.g. being in the top 10 or having a badge of "Expert" or having a nicer avatar? In other words, do you think that gamification could be attractive to the point where an employee accepts, perhaps subconsciously, data being collected about them as the reward compensates those concerns and perhaps makes them less noted?

8. Do you think that gamification will drive employees to work more, in terms of time and efficiency, in order to be listed in the top employees' leaderboard or to get more points or badges, or to enhance their avatar etc.? In other words, do you view gamification in certain contexts as a mechanism to get from employees a maximized efficiency and perhaps more than what they would typically need to do? For example, shorter breaks or working overtime to get more points, etc.

9. Do you think that employees should have the right to see what information is stored in the system about their work activities collected by means of gamification and who can view it and for which purposes this information are stored? When and how do you prefer to see that and what would be the main reasons for it?

10. Do you think that the temptation of being listed as a top employee or winning a prize, can make some of the employees do what they would not have done because of some reasons or belief? For example, in a call centre an employee may accept to tolerate the language and the anger to get more points. In a collaborative group, some colleagues may tolerate

End User Interview Questions

the bad quality of the work of other team members so that the team gets better image through gamification.

11. Do you think that the culture and the norms of an organization and the management style affect their views of gamification from the perspective of ethics at work? E.g. certain environments view competition mechanics (points, leaderboard, etc) a natural practice while others view it as a source of stress and unhelpful for the working environment?

12. How do you think that employees' characteristics make a difference on their perception of how ethical a gamification technique is when used for a certain task in their workplace? Some employees, for example, view progress bars unethical because it encourages staff to do tasks in a cursory manner which could be sometimes a bad choice, e.g. when responding to customers in a health centre.

13. Do you have anything to add?

Appendix C

Chapter 6 Appendixes

Interview Questions

Settings:

Points:

Points are given to the tasks that you successfully finish. These points can be used to monitor and assess your performance.

1. Points are pre-defined and will be given to anyone who finishes the task
2. Points are calculated according to the way the task was performed

Also, the policy for receiving the points could encourage individual performance or group performance:

1. Points can be given on individual basis showing staff's individual performance
2. Points can be given on a group basis showing the group's performance

The availability of the points can be as follows:
The achieved points are:

1. Visible to everyone in the working place
2. Visible to the relevant colleagues of yours
3. Visible to the managers only
4. Visible to you only

Could you please specify your preferences regarding the given setting and the reason behind your choices? (Do you like to receive points at all?)

Interview Questions

Virtual Badges:

According to the work place policies and the points that each employee achieves, some badges are possible to be given to staff.

1. All the possible badges and the route to achieve them are known to the staff
2. Some of the badges and route to achieve them are hidden to the staff

The availability of the badges could be as follows:
The achieved badges are:

1. Visible to everyone in the working place
2. Visible to the relevant colleagues of yours
3. Visible to the managers only
4. Visible to you only

Could you please specify your preferences regarding the given setting and the reason behind your choices? (Do you like to receive virtual badges at all?)

Interview Questions

Leaderboard:

Based on the points you have received, leaderboards are created. The top staff of the company are available in the leaderboard with the number of achieved points.

Leaderboards can:

1. Be available to everyone
2. Be available to your colleagues only
3. Be available to you and your managers only
4. Be available to you only (others are anonymised, you only see your own place in the working place)

Could you please specify your preferences regarding the given setting and the reason behind your choices? (Do you like to have a leader-board in your work place?)

Interview Questions

Goal:

Every workplace is trying to fulfil some sub-goals to achieve its higher business goal. These goals can be set in two ways:

1. Be given to the staff with exact sub-tasks needed to be performed to achieve the final goal. In this case, the progress of the staff with the sub-tasks can be captured:
   - The progress can be available to:
     (1) Everyone
     (2) Relevant colleagues only
     (3) Managers only
     (4) Employee only
2) Be given to the staff and allow the staff to decide how to perform the tasks to achieve the goals

Could you please specify your preferences on the settings for whether the goals to be pre-defined or not.

Also, could you please specify your preferences on the availability of the information when the setting is set to breakdown the tasks into smaller tasks.

Interview Questions

Performance and Feedback:

Employees' performance can be calculated by the use of gamification. They can be available through the system in the form of charts or tables.

The performance can be:
1. Updated real-time
2. Updated at the end of each day
3. Updated weekly
4. …

in addition to the charts and tables available to the employee, feedbacks could be given to the employees based on their performance. The feedback could be:
1. system generated
   - real-time
   - daily
   - weekly
2. generated by managers
   - daily
   - weekly
   - monthly
   - yearly

Could you please specify your preferences on the given settings about the feedback and performance by the use of software-based motivation?

Interview Questions

Promotions and Bonuses:

According to workplace’s policies, they can decide to provide promotions and bonuses for the staff. The decision can be made based on the performance of the employees. The policy for decision making could be:

1. transparent and pre-defined. Everyone in the workplace knows that how promotions and bonuses can be achieved
    - bonuses could be in a very limited number, only available to a few top performers
    - Bonuses could be smaller in price, but available to more staff
2. Managers will assess the performance of each employee and make decisions on the promotions and bonuses to be given.

Could you please specify your preferences on the given settings?

Complete Description of Personas

Mary:

Overall statement: Mary is a collaborative, hard-working, privacy sensitive person. She doesn't appreciate elements introduced by software-based motivation and does not find them motivating.

[Preferred method] Mary finds it more encouraging to know how many points she is going to receive when she performs a task. She always tries to perform with the highest quality and receiving points does not mean a lot to her and she will keep working as normal. **[Privacy preference]** She is OK with the points to be available to her managers only as she thinks they are the decision makers and the ones who will assess her performance, and there is no point in letting others know about points you have received. **[Collaboration nature]** She likes to collaborate with others and likes to achieve points on a group basis rather than individually. She believes that in a professional environment, everyone will work and no one will be pulling anyone else’s' weight.

[Discouragement] Mary does not appreciate receiving virtual badges, as she believes that those who should know about her abilities already know it. She thinks that it will encourage her to pretend to be someone she is not in order to achieve a certain badge. **[Privacy preference]** However, she thinks that if there are badges, they can be available to her relevant peers as this does not carry detailed information about how she works. **[Discouragement]** She also does not like to explore for badges and likes to know about all possible badges that can be achieved and how they can be achieved. Mary also does not like to appear in a leader-board, however, if there is one available, she wants to have a leader-board of relevant colleagues only.

[Preferred method] In order to fulfil her goals, she likes to be told what steps are needed to be taken. Having this steps and information about their fulfilment available to relevant colleagues, she believes that this can help finishing the final task with better quality.

[Performance and feedback preference] She likes to know about her achievements on a real-time basis. However, she wants to receive daily or weekly feedback which is created by her manager rather than a report made by computer. She believes that managers can feel the work, but a computer can't.

[Incentive preference] She also believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

Complete Description of Personas

John:

Overall statement: John is a collaborative person who finds elements introduced by software-based motivation interesting, he likes to share his detailed working information with his relevant colleagues and his skills with everyone within his workplace.

[Preferred method] John likes to receive pre-defined points for the tasks he is performing. He believes that if managers are going to give the points, his focus from work will be shifted towards satisfying his managers and this will eventually increase his stress at work. **[Collaboration nature]** John doesn't like to be compared with all employees within his workplace, however, he enjoys an inner-group competition. **[Privacy preference]** He finds it motivating to have points available to relevant colleagues. That is why he wants to have a leader-board that only promotes competition amongst relevant colleagues.

[Preferred method] John likes the idea of badges, and he finds it less personal than points. **[Privacy preference]** Therefore, he likes his badges to be available to everyone within the workplace. Others can also use the badges and find his skills and ask for his help when they need. **[Motivation]** John finds it motivating and exciting to have some hidden badges. He likes to explore new things and believes that this will change his job to become routine.

[Preferred method] John likes to be told the steps he needs to take to achieve a goal. However, he wants to be able to choose how to perform those given sub-tasks. **[Privacy preference]** He believes that the information about the progress on the sub-tasks should be available to everyone who is working on same projects. Others may be waiting for a task to be finished and this will help them to know when the task is likely to be finished.

[Performance and feedback preference] John likes to receive his achievements on a real-time basis. However, he wants to receive weekly feedback generated by his manager rather than the computer. He believes that humans are not robots and it is necessary for managers to assess their performance and not rely on a computer's report only.

[Incentive preference] He believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

Complete Description of Personas

Paul:

Overall statement: Paul does not like software-based motivation, however, if he has to use it, he will get very competitive in order to do his best and be amongst the winners. He just wants to be told what he has to do and doesn't like to make decisions.

[Motivation] Paul does not like the idea of software-based motivation. However, if he finds himself in such a system, he will fight for it. He doesn't promote competition, but if he has to do it, he will do his best to be in the top performers.

[Preferred method] Paul likes to receive pre-defined points. He believes that managers can get biased or not recognise the quality of his work. But if the points are pre-defined, then he is sure that there was no misjudgement. **[Privacy preference]** He believes that if the points are available to his managers only, he will continue as normal, but if others can see his points, he will do his best to be amongst the top performers. As long as his relevant colleagues can see his points, he will not be stressed, but if it is going to be available for everyone, he finds it stressing.
[Collaboration nature] He also wants to receive points on an individual basis. He believes that receiving points on a group basis will not represent his true effort, others may not work as hard as he is working.

Paul doesn't like to have a leader-board in the environment, but if there is any, **[privacy preference]** he wants it to be available to everyone. He believes that a leader-board shows only how many points you have achieved and where you reside amongst everyone else. It doesn't show detailed information about you.

[Preferred method] He likes the idea of badges, however, he wants to know exactly how many badges are there and how they can be achieved. **[Discouragement]** He believes if someone has a badge that he doesn't, it puts pressure on him to receive that badge, and if he fails to do that, he will feel frustrated and this will decrease his quality of work in general.

[Preferred method] He wants to be exactly told what to do, without freedom of choosing how to perform. He believes that this will keep the consistency of the work and ensures the quality of the final product. He believes that choosing how to perform an important task is a difficult and stressful task.
[Privacy preference] Paul thinks that the information related to the progress of these sub-tasks should be available only to those who are related to the tasks and no one else.

[Performance and feedback preference] Paul wants to see the result of his performance and achievements on a real-time basis. He also believes that at the end of the day, a computer generated report should tell him how well he did. He doesn't want the managers to assess his works, he believes that humans are biased and can have mistakes in their judgements.

[Incentive preference] He believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

Complete Description of Personas

Mark:

Overall statement: Mark cares about the quality of his work and will not decrease the quality if he can get points with lower quality. He is collaborative and doesn't like social recognition. He will keep his points low enough so that he is not attract any attention to himself.

[Preferred method] Mark believes that points should be calculated according to the quality of his work. He will not decrease the quality of his work just to get the points if the points were pre-defined, but he finds it more fair if quality was measured. **[Collaboration nature]** He also likes to collaborate with others and does not like competition. **[Privacy preference]** He is fine with the points to be available to his relevant colleagues as long as they do not show off their achievements. In that case, he limits the visibility to managers only if he can. He has no appreciation for social recognition, but likes to use software-based motivation as a self-monitoring mechanism.

[Preferred method] Mark doesn't like to explore and have surprise badges. He wants to know how many badges are available and how they can be achieved. **[Privacy preference]** It is OK with mark for his relevant colleagues to have access to his achieved badges as long as there is no showing off.

[Preferred method] Mark likes the idea of having an anonymous leader-board in his working environment. It can help him monitor his performance. **[Discouragement]** But he thinks that it is very stressful to have a leader-board that compares real individuals with each other. He doesn't even like to appear in a leader-board and if he appears in a leader-board and others talk about it to him, he will keep his points at a point that his name is removed from the leader-board.

[Preferred method] He likes to have pre-defined sub-goals. It helps him better understand how the task should be performed. **[Privacy preference]** But he only wants the information about the progress to be available to him. Not even his managers. **[Discouragement]** He believes that it will give very detailed information about his work habits and if managers have access to such information, will make him to change his working habits and he finds it very pressuring.

[Performance and feedback preference] He likes to see the achieved points on a real-time basis. However, he doesn't want the opinion of the managers anything sooner than monthly, or even a feedback to be given after the task is finished. He likes to have the human touch in the feedback, he believes that a computer cannot feel his work.

[Incentive preference] He believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

Complete Description of Personas

Clara:

Overall statement: The quality of work is important for Clara, however, it is important for her to not fall behind her colleagues. Therefore, she may decrease the quality of her work if she can receive the same points. She is an explorer and wants to have surprises in her work. She is concerned about her detailed work details, however, she finds it helpful for others to be able to access her skills set.

[Preferred method] Clara wants to receive points according to the quality of her work. **[Discouragement]** Otherwise, she will be motivated to decrease the quality to just receive the points. **[Collaboration nature]** She also likes to collaborate with others in achieving the goals. **[Privacy preference]** She only wants her points to be available to her managers only and she finds it stressing if it is available to others.

[Preferred method] She likes the idea of having some hidden badges in the environment and **[privacy preference]** she wants her virtual badges to be available to everyone as it is not that much personal. It shows her skills and others can use them to find her when they need help in an area that she is strong.

[Preferred method] She is fine with having a leader-board that **[privacy preference]** only shows relevant colleagues and promotes a friendly inner-group competition. **[Discouragement]** Having a leader-board available to everyone will make her to be quick which will decrease the quality of her work at the end.

[Discouragement] Clara doesn't like to be told how to achieve a goal. She likes to be able to decide how she is going to perform. She believes that defining the steps towards achieving a goal will remove creativity. **[Privacy preference]** However, if she can decide and define the tasks she is going to perform, she prefers the information about her progress to be available to her managers only.

[Performance and feedback preference] Clara doesn't like a real-time update of her achievements. She believes that this will kill the joy of finishing a task. She wants to see her achievements at the end of the week. In addition, she believes that a feedback is better to be created by managers as they can tailor it to individuals, and she likes to receive the feedback from her managers on a monthly basis.

[Incentive preference] She believes that it is better to have smaller prizes in higher quantity rather than having a few bigger prizes.

Complete Description of Personas

Ben:

Overall statement: Ben enjoys competing with the people he knows and are doing similar jobs. It is important for him that the quality of his work is considered in the software-based motivation. He is an explorer and likes to have surprises in his work. He likes to share his achievements with the people he knows and have a friendly competition with them. It is important for him to win big at the end, he thinks that it is not fair for the top winners to receive the same prize as the others.

[Preferred method] Ben wants to receive points according to the quality of his work. He believes that its unfair to have pre-defined points for the tasks. The quality of the task is missing in that situation. **[Collaboration nature]** Ben likes to compete with others from his own department. He likes to have the points available to his relevant colleagues.

[Preferred method] He likes to have hidden badges in the environment, He likes the element of surprise that this mechanism introduces. **[Privacy preference]** He likes the badges to be available to his colleagues from his department, he finds it pointless to have it available for someone he doesn't know.

[Preferred method] He wants to have a leader-board that shows his relevant colleagues, it will motivate him to work harder in order to appear on the leader-board, however, he finds it irrelevant for others from different departments to be compared with each other in a same leader-board.

[Preferred method] He likes to have the sub-tasks given to him as guidelines, but he likes to be free on how to perform the tasks. **[Privacy preference]** He finds it too personal for others to access on the progress he is making in achieving a task, however, if his task is related to others, then he think its a rational decision to make it available for them.

[Performance and feedback preference] He wants to have his achievements to be available to him on a real-time basis, however, he wants his managers to see them on a weekly basis. He also likes his managers to assess his work and give him feedback, but he doesn't want to receive frequent feedback. Once in a month is what he would be fine with. He likes it when he can use this software-based motivation as a daily basis self-monitoring mechanism.

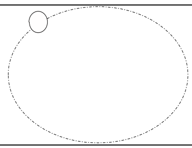
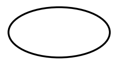
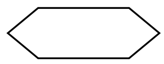
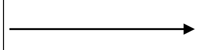
[Incentive preference] Ben believes that there should be limited number of prizes, but bigger in amount. He thinks it is not fair for the first person to receive a prize which is relatively similar to the prize for 20th person.

Appendix D

Chapter 7 Appendixes

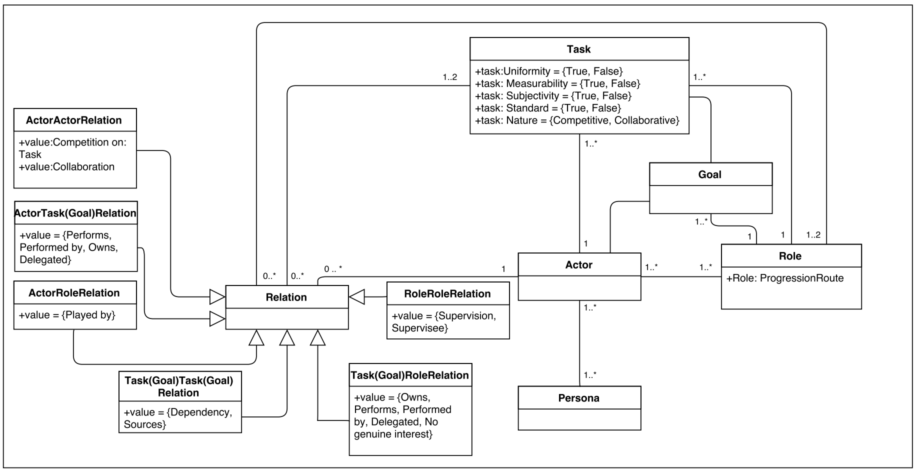
Earlier Version of DMML

Table 1. SbMML Notation

Concept	Meaning	Notation	Example
Role with boundary	A set of functions and tasks expected to be performed by Actors		Manager, Employee, Call centre agent
Persona	A fictional character that represents a set of preferences and expected behaviours towards specific settings of SbM		
Actor	An actual instance of a person who plays at least one role in the SbM		
Goal	A goal is a desired result that the system plans to achieve		Reducing the anger of customers in a call centre
Task	A piece of work to be done or undertaken in the SbM		Answering a call in call centre
Relation	Showing the presence of a relation between other concepts in the SbM		
Binder	Binds the attributes to the concept it is applied to		
Attributes	Defines the attributes of concepts	<<Relation Type>> Value::value	
Motive	The motivational element that is being applied to the environment	Motive Name Attributes	Leader-boards, Badges

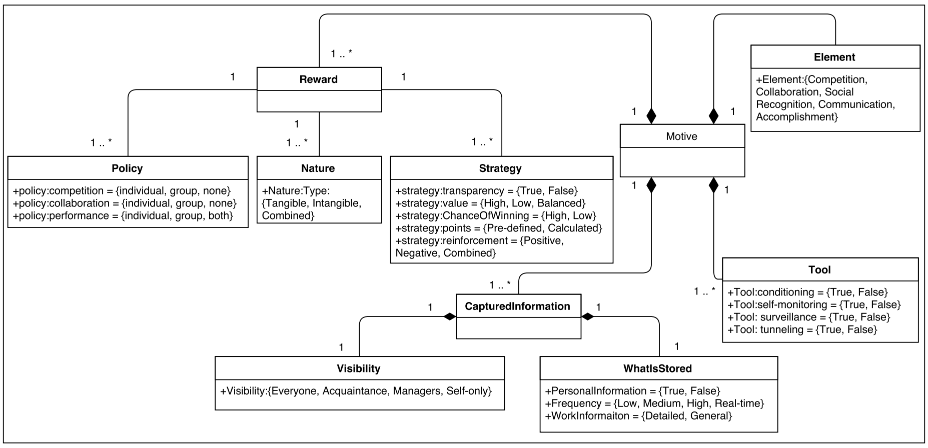
Earlier Version of DMML

Table 2. SbMML Meta-Model (Environment)



Earlier Version of DMML

Table 3. SbMML Meta-Model (Motive)



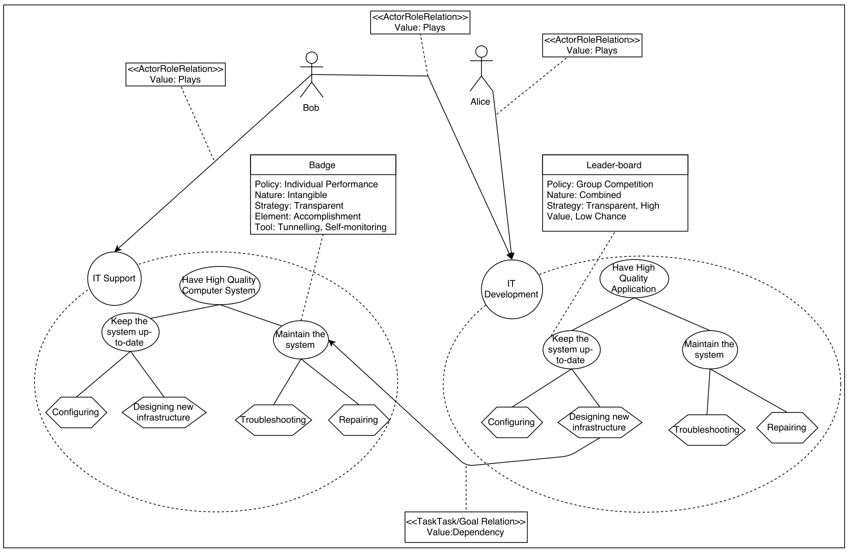
Earlier Version of DMML

Scenario 1:

Alice is a member of the development team. Bob is a teammate with Alice in the development team, as well as a member of the IT support team. The development team is tasked with designing a new UI for the customer portal as there has been reports of the current UI not being very clear of what can be done through the portal entirely. Each member of the team is asked to design a UI and at the end, the designs will be polled for the best design and ideas as the final UI. The winner design will get the winner points. If the feature of the design of members is used in the final artefact, they will receive some points for their contribution.

Problem:
Bob is in the IT support team as well and he is responsible for maintaining and repairing faults with the computer systems. Bob will receive points for fixing the incidents on a given time. If Alice needs a hardware support that relies on Bob, since they are both competing on the same goal and Alice's tasks depends on Bob's task to be performed, Bob may hinder and delay as much as he can so he can have more time and come up with a better design to win more points.
This situation is more likely to happen if there is a negative reinforcement strategy followed by the organisation.

Model:



Earlier Version of DMML

Formal Reasoning:

foreach *aa* ∈ *AA* **do**
  if *rel == "Competition"* **then**
    t_1 = t
    a_1 = a_i
    a_2 = a_j
      foreach *tt* ∈ *TT* **then**
        if *t_1* ∈ *tt* ==*"true"* **and** *rel* == *"Dependency"* **then**
          t_2 = t_j
          foreach *at* ∈ *AT* **do**
            if *({a_1, t_2, performs}* ∈ *at == "false"* **and** *{a_2, t_2, performs}* ∈ *at =="true")* **or** *({a_1, t_2, performs}* ∈ *at =="true"* **and** *{a_2, t_2, performs}* ∈ *at == "false")* **then**
              print *"There is a risk"*

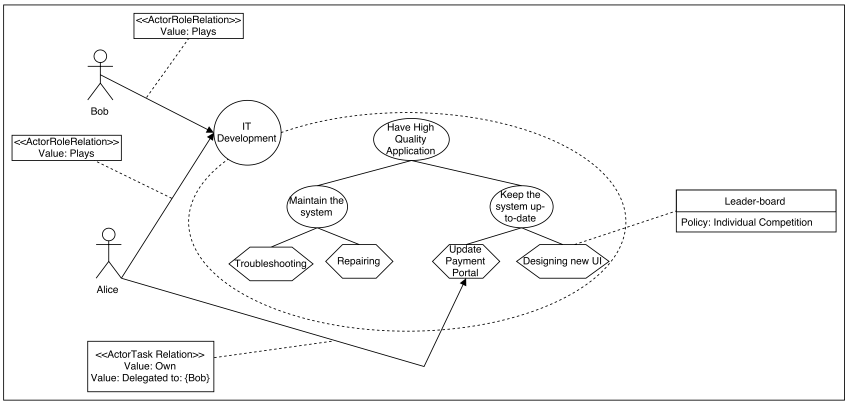
Scenario 2:

Alice and Bob are competing on designing a UI for the web application of the organisation. Alice also needs to finalise the update to the payment portal of the customer side of the web application. Alice is short in time and cannot finish her update for the portal. She asks her manager if she can delegate the task to Bob and her managers agrees to that if Bob is OK with this.

Problem:
Since Bob is competing with Alice on the design of UI, there is a danger of Alice offering to let Bob win the design in order to make it as an offer that Bob cannot reject, or even Bob asking Alice to let him win in order to accept the delegated task. This is not aligned with the business goal of the organisation and will decrease the quality of the design. Since there is only one of the two are going to work on the task and Bob knows that he will win the task and there is a risk of him reducing the quality of his work as he sees himself the winner for the design already.

Earlier Version of DMML

Model:



Formal Reasoning:

foreach at ∈ AT **do**
  if *rel == "delegated"* **then**
    t_1 = t
    a_1=a
    find (*at={t_1, own}*)
    a_2=a
    if find(*aa={a_1, a_2, competition, t} == "true"* **then**
      print "*there is a risk*"

Earlier Version of DMML

Scenario 3:

Alice, Bob, and Mary are team 1 of the development team. Jack, Matt, and Suzy are team 2 of the development team. Team 1 is mainly responsible for developing the front-end, and team 2 is mainly responsible for back-end development of the web application. Each team will receive points that will help them to level up and receive badges. Each time a team levels up, the company provides team members with additional holidays according to the effort needed for that levelling up.

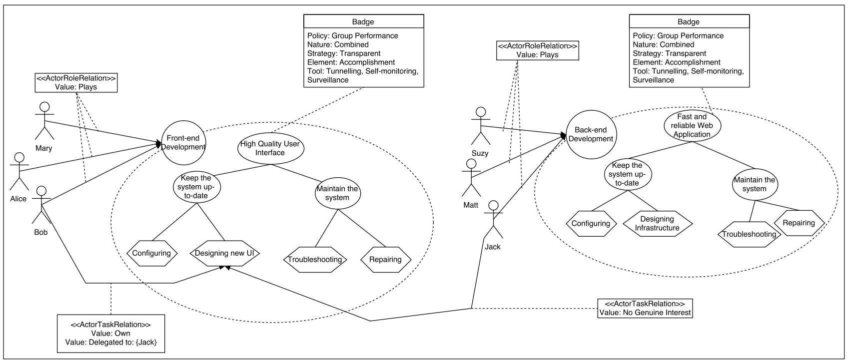
Team 1 is given a task for updating the design of the UI as there were complaints about this current design, causing the loss of a great percentage of customers. The managers has given this task a high priority and are asking team 1 to update the UI as soon as possible.

Bob calls sick and cannot make it to work for a few days. The managers delegate Bob's tasks to Jack from team 2.

Problem :

Since Jack does not share any interest of meeting the deadline and knowing that the others will do the job as it is important for them, he may put minimum efforts and rely on the fact that the other team members will do the task at the end.

Model:



Earlier Version of DMML

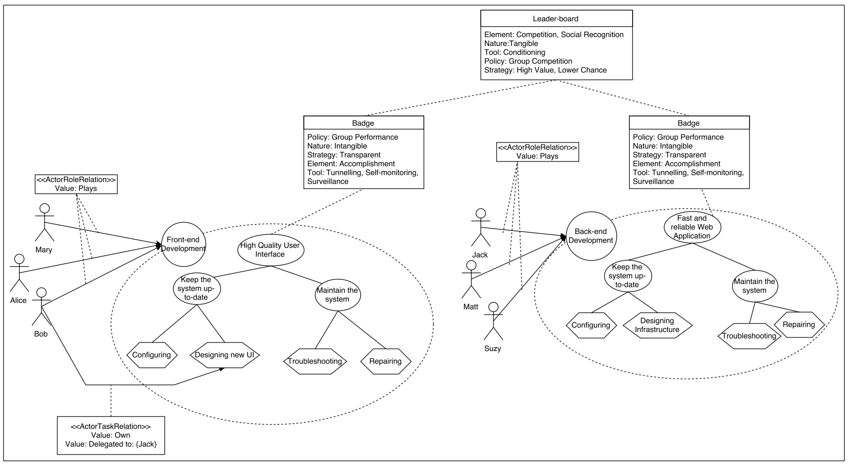
Formal Reasoning:

foreach $m \in M$ **do**
  if {*competition, group*} ∈ m.reward.policy ==“true” **and** {*performance, individual*} ∉ m.reward.policy == “true”
  then
    tasks=[]
    foreach $t \in T$ **do**
      if m.assigned == “*true*” **then**
        tasks.append(*t*)
    foreach $at \in AT$ **do**
      foreach t **in** *tasks* **do**
        if $t \in at$ == “*true*” **and** *rel* == “*delegated*” **then**
          a_1 = a
          foreach *t* **in** *tasks* **do**
            if ({*a_1, t, own*} ∈ *TT == “false*”) **then**

Scenario 4:
Alice, Bob, and Mary are team 1 of the development team. Jack, Matt, and Suzy are team 2 of the development team. Team 1 is mainly responsible for designing the UI, and team 2 is mainly responsible for back-end development of the web application. Each team will receive points that will help them to appear on the leader-board. At the end of each week, the team with the highest score will receive a token. At the end of each year, the team with the highest token received will be given an extra raise to the team members salary. The points are given on a group basis.
Team 1 is given a task for updating the design of the UI as there were complaints about this current design, causing the reduction of a percentage of customers. The managers has given this task a high priority and are asking team 1 to update the UI as soon as possible.
Bob calls sick and cannot make it to work for a few days. The managers delegate Bob’s tasks to Jack from team 2.

Problem:
Since it is in the interest of Jack for team 1 to lose, not only social loafing may happen, which is Jack relying on others to perform the job, Jack may intentionally hinder the job and cause a delay so his team wins and receives the token.

Earlier Version of DMML



Formal Reasoning:

```
foreach m ∈ M do
  if m.reward.policy == {collaboration, group} and m.reward.policy == {performance, individual}   do
    tasks=[]
    foreach t ∈ T do
      if m.assigned == "true" then
        tasks.append(t)
    foreach at ∈ AT do
      foreach t in tasks do
        if t ∈ at == "true" and rel == "delegated" then
          a_1=t
          foreach t in tasks do
            if ({a_1, t, own} ∈ TT == "false") then
              actors=[]
              foreach t in tasks do
                if t ∈ at == "true" and rel == "own" then
                  actors.append(a)
                foreach aa ∈ AA do
                  foreach a in actors do
                    if {a_1, a, competition} ∈ aa == "true" then
                       print "there is a risk"
```

Earlier Version of Formal Specification for DMML

1 Environment

Definition 1 (**Roles**)**.** Let $\mathcal{R} = \{r_1, r_2, r_3, \ldots, r_i\}$ be the set of *Roles* in the environment.

Definition 2 (**Personas**)**.** Let $\mathcal{P} = \{p_1, p_2, p_3, \ldots, p_i\}$ be the set of identified personas in the environment.

Definition 3 (**Actors**)**.** Let $\mathcal{A} = \{a_1, a_2, a_3, \ldots, a_4\}$ be the set of actors in the environment. Where $\forall a \in \mathcal{A}, \exists p \in \mathcal{P} | p \xrightarrow{assigned} a$

Definition 4 (**Progression Route**)**.** Let $\mathcal{PR} = \{pr_1, pr_2, pr_3, \ldots, pr_i\}$ be the set of various progression routes. Every $pr_i \in \mathcal{PR}$ can be defined as follows:
$\mathcal{PR} = \{pr | pr \subset \mathcal{R}, \forall r \in pr, r \in \textit{same progression route}\}$ where different orders of elements in each pr are not equal to each other.

Definition 5 (**Tasks**)**.** Let $\mathcal{T} = \{t_1, t_2, t_3, \ldots, t_i\}$ be the set of tasks in the environment. Every $t_i \in \mathcal{T}$ can be defined as follows:
$\mathcal{T} = \{t | t \textit{ is a task in the environment}\} and$
$\forall t \in \mathcal{T}, t = \{\langle \textit{Uniformity, Measurability, Subjectivity, Standard, Nature} \rangle |$
$\langle \textit{Uniformity, Measurability, Subjectivity, Standard, Nature} \rangle \in \{true, false\}\}$

Definition 6 (**Relations**)**.** Let $\mathcal{AA} = \{aa_1, aa_2, aa_3, \ldots, aa_i\}$ be the set of ActorActorRelations. Every $aa \in \mathcal{AA}$ can be defined as follows:
$aa_i = \{r_i, r_j, rel, t_i | r_i, r_j \in \mathcal{R}, rel \in \{\textit{Competition, Collaboration}\}, t_i \in \mathcal{T}\}$

Let $\mathcal{AT} = \{at_1, at_2, at_3, \ldots, at_i\}$ be the set of ActorTasksRelations. Every $at \in \mathcal{AT}\}$ can be defined as follows:
$at_i = \{a_i, t_i, rel\} | a_i \in \mathcal{A}, t_i \in \mathcal{T}$,
$rel \in \textit{Performs, Performed by, Owns, Delegated, No genuine interest}\}\}$

Let $\mathcal{AR} = \{ar_1, ar_2, ar_3, \ldots, ar_i\}$ be the set of ActorRoleRelations. Every $ar \in \mathcal{AR}$ can be defined as follows:
$ar_i = \{a_i, r_i, Playedby | a_i \in \mathcal{A}, r_i \in \mathcal{R}\}$

Let $\mathcal{TT} = \{tt_1, tt_2, tt_3, \ldots, tt_i\}$ be the set of TaskTaskRelations. Every $tt \in \mathcal{TT}$ can be defined as follows:
$tt_i = \{t_i, t_j, rel | t_i, t_j \in \mathcal{T}, rel \in \{Dependency, Source\}\}$

Let $\mathcal{TR} = \{tr_1, tr_2, tr_3, \ldots, tr_i\}$ be the set of TaskRoleRelations. Every $tr \in \mathcal{TR}$ can be defined as follows:
$tr_i = \{t_i, r_i, rel | t_i \in \mathcal{T}, r_i \in \mathcal{R}$,
$rel \in \{Owns, Performs, Performedby, Delegated, Nogenuineinterest\}\}$

Earlier Version of Formal Specification for DMML

Let $\mathcal{RR} = \{rr_1, rr_2, rr_3, \ldots, rr_i\}$ be the set of RoleRoleRelations. Every $rr \in \mathcal{RR}$ can be defined as follows:

$rr_i = \{r_i, r_j, rel | r_i, r_j \in \mathcal{R}, re; \in \{Supervision, Supervisee\}\}$

2 Motives

Definition 7 (**Motives**). Let $\mathcal{M} = \{m_1, m_2, m_3, \ldots, m_i\}$ be the set of motives that can be available in the environment. Every $m_i \in \mathcal{M}$ can be defined as follows:
$\mathcal{M} = \{m | \forall m_i, m = \{\textit{reward, tool, captured information, element}\},$
$m \xrightarrow{assigned} \{t_i, \ldots, t_i\}\}$

Definition 8 (**Reward:**). Let $\mathcal{RW} = \{rw_1, rw_2, rw_3, \ldots, rw_i\}$ be the set of *Rewards* that motives can have. Every $rw_i \in \mathcal{RW}$ can be defined as follows:

$\mathcal{RW} = \{rw_1^i | \forall rw_i, rw_i = \{\text{policy, nature, strategy}\}\}$ Where:

$policy = \{type, value | type \in \{competition, collaboration, performance\}, value \in \{individual, group, none\}\}$

$nature = \{type | type \in \{Tangible, Intabgible, Combined\}\}\}$

$strategy = \{transparency, value, ChanceofWinning, points, reinforcement | transparency \in \{True, False\}, value \in \{High, Low, Balanced\}, ChanceofWinning \in \{High, Low\}, points \in \{Pre{-}defined, Calculated\}, reinforcement \in \{Positive, Negative, Combined\}\}$

Definition 9 (**Element:**). The elements in each m can be defined as follows:

E can be defined as $\{e_1, e_2, \ldots, e_i\}$ where
$e_i \in \{competition, collaboration, SocialRecognition, Communication, Accomplishement\}$

Definition 10 (**Tool:**). The tool for each motive can be defined as $\mathbf{TL} = \{tl_1, tl_2, tl_3, \ldots, tl_i\}$ where$\forall tl_i, tl_i = \langle$conditioning, self-monitoring, surveillance, tunneling$\rangle |$ $\langle$conditioning, self-monitoring, surveillance, tunneling$\rangle \in \{true, false\}$

Definition 11 (**Captured information:**). CI can be defined as$\forall CI, CI_i = \{\langle$visibility, what is stored$\rangle\}$where
$visibility \in \{$everyone, relevant, managers, self-only$\}$
and*what is stored*is defined as
$\{\langle$personal information, frequency, work information$\rangle |$personal information $\in \{true, false\}$, frequency $\in \{low, medium, high\}$, work information $\in \{$detailed information, general information$\}\}$

Appendix E

Chapter 8 Appendixes

Questions - Lab session 2

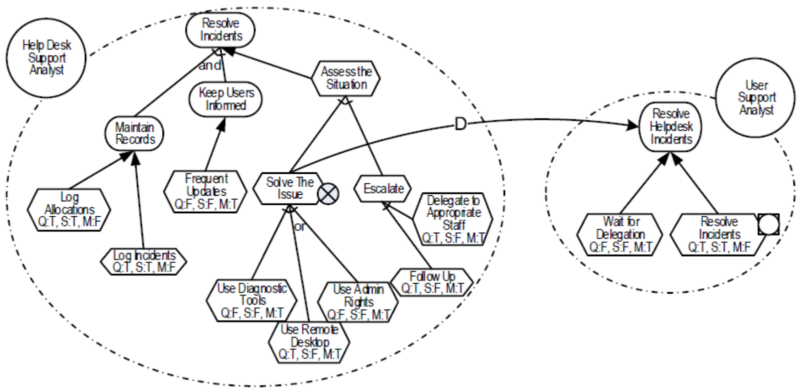
Task 1. Please read the following scenario and analyse the given model. Please list any problems you see with the given model (10 minutes)

In an IT department, the help desk support analyst is responsible to receive and record incidents via phone or email. The help desk support analyst needs to assess the incident and solve the problem using diagnostic tools, admin rights, or remote desktop. In a case where the incident is complicated to solve, the analyst should ask a member of the user support analyst team to solve the problem. The help desk support analyst should remain the owner of the task and be the person who replies and responds to the client.

User support analysts are mainly employees with more advanced skills and are not very interested in solving incidents from individuals. However, as part of their job, they should wait for a delegation of an incident and resolve it.

The employees working in the help desk support analyst team are Alice, Bob, and Jack. The employees in the user support analyst are Paul, Suzy, and Matt.

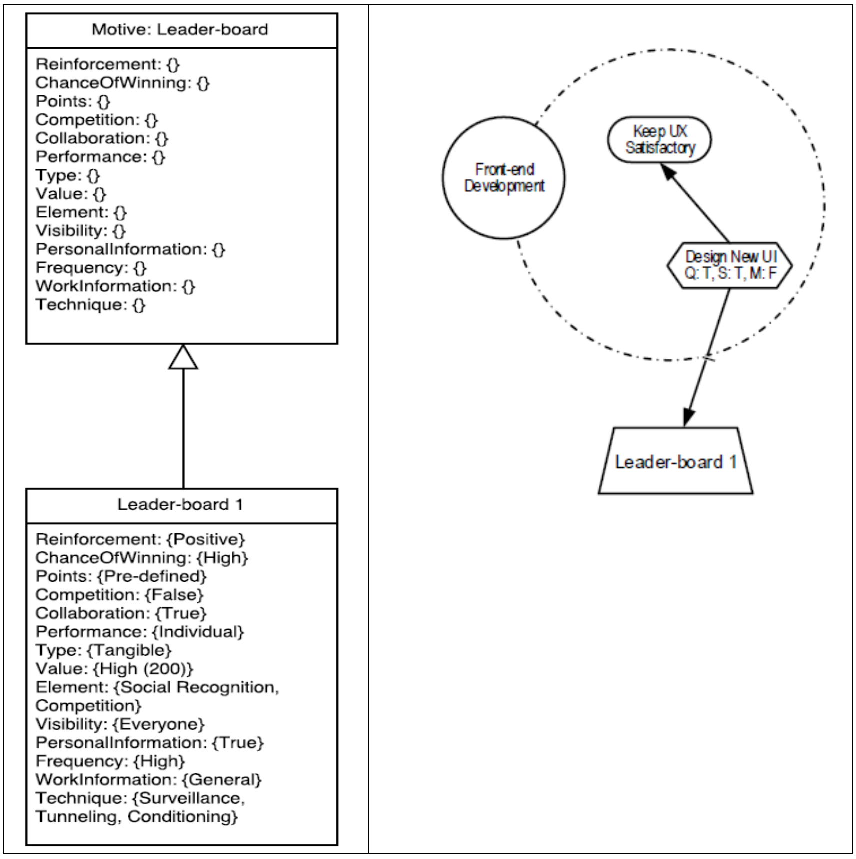
Actor	Agent
Help Desk	Alice
	Bob
	Jack
User Support	Paul
	Suzy
	Matt



Questions - Lab session 2

Task 2. Please read the following scenario and analyse the given model. Please list any problems you see with the given model (10 minutes)

The front-end development of an organisation is tasked with designing a new user interface to keep the user experience at a satisfactory level. As a motivational element, the organisation decides to introduce a leader-board to the environment and give points to the employee with the best design. The design will be assessed by other managers and points will be given to the employees based on the effort needed. At the end of the year, the first employee in the leader-board will be given a 200 GBP Amazon voucher as a prize. The leader-board will be available to everyone in the organisation to that the top employees are known to everyone.



Questions - Lab session 2

Questions - Lab session 2

Task 3. Please read the following scenario carefully and draw a model for it using DMML (20 minutes)

In an IT department, the help desk support analyst is responsible to receive and record incidents via phone or email. The help desk support analyst needs to assess the incident and solve the problem using diagnostic tools, admin rights, or remote desktop. In order to motivate employees, the organisation decides to give badges to the employees. The badges are given based on the points received for finishing the tasks. Each incident that is solved, 10 points are given to the employees. The badges are only visible to the employees inside the help desk support team and other employees will not be able to see the badges each employee has received.

Questions - Lab session 2

Questions - Lab session 2

Task 4. Please answer the following questions (10 minutes):

1. Do you find DMML easy to learn? (please provide your reasons)
    a. Identifying and modelling the constituents in the environment
    b. Identifying and modelling the motives
    c. Identifying the relations
    d. Any other comments

2. Do you think that DMML can model digital motivation properly?
    a. Anything you would add or remove from DMML
    b. Can you model digital motivation using other modelling languages?
        i. If yes, which one does it with more efficiently, why?

Questions - Lab session 2

3. Will you use DMML for modelling a digital motivation? Why?

Scenario - Lab session 2

Scenario:

In a call centre, a team of inexperienced agents and a team of experienced agents exist. They both try to address the issues of the clients. Their daily tasks are the same, but the salary is based on their experience and knowledge. There is another team which is the Training team which is responsible for preparing the new recruits to join the inexperienced agents team. When the call centre recruit new employees, some of the experienced agents will be assigned as trainers to prepare the new recruits for the job.

In the call centre, the agents are tasked with handling the issues of the customers. This involves answering the calls promptly and politely, recording and logging the issue of the client, resolving the issues, and redirecting to the correct person if cannot resolve.

The training team is tasked with teaching necessary knowledge to the new recruits. They need to make sure that the material for classes are updated frequently and the recruits are provided with the materials. They need to make sure that regular hours of training are provided for the recruits and should assess the new employees at the end of the course to make sure that they are ready to join the team.

The new employees must participate in the training sessions provided, study the provided materials, and achieve a minimum acceptance level of knowledge to be able to join the team.

It is an accepted norm in the call centre to compete with people at your own level, and collaborate with people that have different roles.

The call centre decides to introduce digital motivation in the environment to increase the performance and quality of work in different areas which they hope will increase the customer' satisfaction.

To encourage agents to learn more and resolve the issues of the customers, they decide to introduce a leader-board. This will help decrease the number of call redirections for simple issues which will allow more time for issues which are more important to be addressed. To include more people in the leader-board and make it more live, the inexperienced and experienced agents appear in the same leader-board. The experienced agents will receive 5 points for each problem they resolve on their own and the inexperienced agents will receive 7 points to compensate their lack of experience. The top 5 performers of the month will receive 1 day paid holiday added to their annual leave days.

Since the experienced agents have no interest to be involved in the process of training the new recruits, the call centre decides to provide digital motivation for them. However, since it is an educational environment, they decide to avoid competition and encourage the trainers to collaborate with each other.

Therefore, the training team will receive a badge for each of their tasks that they perform at a satisfactory level as a group which the managers will make the final decision based on the outcome of the group.

The new recruits are encouraged to learn as much as they can in various areas and make their expertise profile as diverse as they can. Therefore, they are given badges if they perform at a satisfactory level throughout their trainings. Those who receive the most badges at the end of the trainings and score highest in the assessments will be put in a leader-board and the top three will be provided with free lunch for their first month of work. If there are more than three top performers, the prize will be shared between them (fewer days between more people in accordance to the number of winners)

Scenario - Lab session 2

Reasoning:

1. When there is no genuine interest in performing tasks, the provided rewards are not very appealing for the employees, and the individual performance is not captured, there is a risk of **free riding**.
2. The motives introduced should always be aligned with the environmental values. Some inner environments may have different values from the main environment.
3. When there is a competition which has appealing rewards and the performers of an involved actor in the competition can influence the quality of others which may be promoted to a role which is involved in the same competition (training new staff which will then compete on the same task), there is a risk of **sabotage** (the trainer putting less effort in training new staff)
4. Creating a competition between actors with different competency levels can create tension on both sides (inexperienced may find it impossible to win, experienced may feel pressure if an inexperienced wins)

Scenario and Questions - Lab session 1

Please answer the following questions with regards to the scenario provided for you and the tasked you performed on the scenario

1. Which method is easier to use for modelling digital motivation? Why?
2. Did you find any difficulty learning DMML? Where?
3. For the given scenario, which method provides an easier detection of issues in the design of digital motivation?
4. I feel confident in using DMML
5. Concepts in DMML are clear and understandable
6. In the scenario provided for you, DMML provides a more comprehensive analysis
7. DMML reduced the subjectivity of the analysis
8. DMML enabled to detect issues which are difficult to detect using goal model alone

Scenario and Questions - Lab session 1

9. DMML is useful for modelling digital motivation

10. DMML makes it quicker to detect the issues in comparison to goal model

11. Which method will you use for your assignment? Why?

12. Which method will you recommend to your classmates to use for a digital motivation assignment? Why?

13. Which method will you consider using in the future if you want to design a digital motivation system? Why?

DMML Teaching - Slides

22/06/2017

Digital Motivation Modelling Language

Alimohammad Shahri

What is Motivation?

- Motivation is the "psychological processes that cause the arousal, direction, and persistence of behaviour"
- People need motives to have motivation
- A motive is the substance that can increase the will of a person to perform a particular behaviour

2

What is Software-based Motivation

- The use of software in order to increase motivation and engagement in the users by mainly giving virtual goods
- Examples are:
  - Persuasive Technology
  - Serious Games
  - Gamification

3

Why a New Modelling Language for DM?

- Digital motivation adds new features
- These features are mostly unique to digital motivation
  - Such as encouraging collaboration or competition
- Other modelling languages:
  - Cannot model digital motivation, or
  - Do not take into account all characteristics and requirements
- Failure in detecting these characteristics can be detrimental
- A better requirement analysis

What is Digital Motivation Modelling Language (DMML)?

- DMML is an extension to goal oriented requirements engineering modelling languages
- It uses the concepts and relations provided in GORE and adds some concepts and relations to it
- These additions enable:
  - A better analysis and understanding of introducing a DM to a BIS
  - Detection of issues which are difficult or not possible to detect
  - …

How we did it?

To know DM better, to find it's problems, to identify what's important, to find solutions, and to clarify our findings, we performed the following:

Exploration in the field	Confirmation and Enhancement	Clarification	Elicitation of users preferences	Confirmation
• 6 interviews with experts in the field • Almost 4 hours of semi-structured interviews • Content analysis	• 40 experts in the field participated in an open ended survey with 77 questions • Content analysis on the comments provided by the experts • Descriptive statistics	• 12 semi-structured interviews with 7 employees and 5 managers from various disciplines • Almost 5 hours of interviews • Content analysis	• 10 semi-structured interviews with employees from various disciplines • More than 6 hours of interviews • Segmentation and creating personas	• Survey with 10 psychologists asking about their opinion on the created personas

6

DMML Teaching - Slides

22/06/2017

DMML

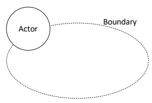
- DMML separates the concerns into two aspects:
  - The environment it is being introduced to
  - The motives being added to the environment

DMML - Environment

- Environment:
  - Actors
  - Tasks and Goals
  - Environmental Values
  - Relations
  - Human Factors
    - Employees
    - Personas

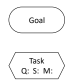
DMML – Environment: Actors

- An actor is responsible for commencing a business process
- Making decisions on how the process should be performed
- An actor can refer to a person, a job position, or a machine
- An individual can play as multiple actors
  - Senior lecturer and principal manager



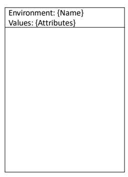
DMML – Environment: Tasks and Goals

- Goals are objectives which a system should achieve
- Goals should be achieved through cooperation of actors in the intended software and in the environment
- Task is an activity that needs to be accomplished within a defined timescale
- It can be broken into smaller assignments
- At least one assignment should be commenced for the task to be considered under execution
- Tasks could be:
  - Quality-oriented
  - Subjective
  - Have Measurable Outcome



DMML – Environment: Environmental Values

- It is important to know what the environment values
- It could have an impact on the acceptability of DM
- The values could vary
  - Collaboration
  - Competition
  - Mental health of the employees
  - More productivity
  - Higher quality
  - …
- If the design of DM is not aligned with the values, it can have adverse side effects
  - Encouraging employees to compete with each other where collaboration is the norm



DMML – Environment: Human Factors (Agents and Personas)

- Refers to the actual employees and humans in the BIS
- It is important to have a list of employees for each position
  - Sometimes, people have multiple responsibilities that can allow them to exploit the situation
- Employees personalities is another important aspect which can help in designing a better DM
  - Personas can be created
  - Ask employees what they like about various aspects of DM
  - Create clusters of employees who have most similar preferences

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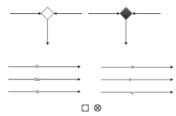
DMML – Environment: Personas

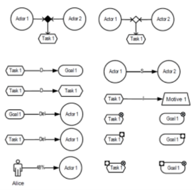
- Persona
  - Incentives
    - Quality based
    - Availability
    - Value
    - Chance of winning
  - Performance and feedback
    - Frequency
    - Generation type
  - Privacy
    - Self-only
    - Acquaintance
    - Managers
    - Everyone
  - Goal setting
    - Control over the settings
    - Opt-out possibility
  - Collaboration nature
    - Collaborative
    - competitive

DMML – Environment: Relations

- Relations can be between:
  - An agent and a persona
    - Which personas can be mapped to agents
  - Actors and agents
    - Which agents play the actors
  - Two agents and a task
    - Is any of the agents delegating a task to another
  - Actors and a task
    - Are there any actors competing/collaborating on a task
    - Is the actor interested in the task (or we need to add some sort of motivation?)
    - Who owns the task? (who is responsible)
  - Personas and actors
    - Which persona represents the agents playing an actor?
  - Actors
    - Who supervisors whom?
    - Which actor can be promoted to another?
  - Tasks
    - Which task depends on the other



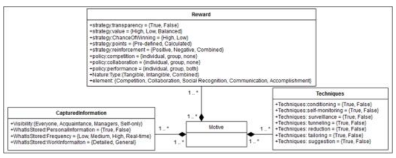
DMML – Environment: Examples for relations' notations



DMML-Motive

- There are three main aspects of the motive that have an impact on the design of the SbM being introduced to the BIS
  - Reward
  - The information captured by means of SbM
  - Techniques used to increase motivation and engagement

DMML-Motive



DMML-Motive: Reward

- Policy
  - Competition
  - Collaboration
  - Performance
- Element
  - Social Recognition
  - Communication
  - Accomplishment
- Nature
  - Tangible
  - Intangible
  - Combined
- Strategy
  - Transparency
  - Value
  - Chance of winning
  - Points
  - Reinforcement

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DMML-Motive
Captured Information

- DM cannot run without capturing information
- But:
  - Who has access to the information
  - What is captured
- Visibility
  - Everyone
  - Acquaintance
  - Managers
  - Self-only
- What is stored
  - Work information or personal information?
    - General or detailed?
  - Frequency
    - Real-time or at the end of the day/week/month

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DMML-Motive
Techniques

- Conditioning (using positive reinforcement to persuade people)
- Self-monitoring (giving the chance to people to know what they are doing)
- Surveillance (allowing people to monitor the performance of others)
- Tunnelling (leading through predetermined steps)
- Reduction (making complex tasks simpler)
- Tailoring (giving personalised messages)
- Suggestion (giving the right message at the right time)

DMML-Motive:
Reward-Policy

- The policy of the rewarding can encourage competition or collaboration
  - The competition or collaboration can be between groups or individuals
- The policy can collect the performance of the groups or individuals
  - Each has its cons and pros
  - Individual performance monitoring will ensure that no one will rely on others, however, it can create unwanted competition
  - Group performance encourages collaboration but may encourage some to rely on others to finish the tasks

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DMML-Motive:
Reward-Element

- There are various elements originating from game design that can be used in SbM to increase motivation and engagement in users:
  - Social recognition
  - Communication
  - Accomplishment
  - …

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DMML-Motive
Reward-Nature

- Any reward that SbM provides can be:
  - Tangible
    - Money
    - Holiday
    - Food voucher
    - …
  - Intangible
    - Virtual badge
    - Social recognition
    - Points
    - …
  - Or a combination of both

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DMML-Motive:
Reward-Strategy

- SbM can follow various strategies in order to increase motivation in its users:
  - Transparent or non-transparent
  - High value, scarce rewards
  - Low value, reachable rewards
  - Pre-defined or calculated points
  - Positive or negative reinforcement

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DMML-Motive: Captured Information

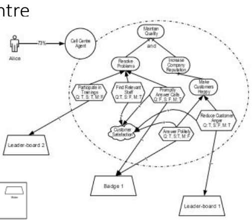
- There are two aspects of the captured information that hold value in the design of SbM:
  - It can be visible and available to:
    - Everyone
    - Acquaintance
    - Managers
    - Self-only
  - The stored information:
    - Could be personal or work related information
      - Work related information could be into details or just general
    - Could be low, medium, high in frequency, or even real-time if the nature of the tasks allows

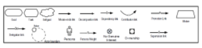
DMML-Motive Techniques

- There are seven different techniques that can be used to increase the motivation in the users of SbM
  - Conditioning
  - Self-monitoring
  - Surveillance
  - Tunnelling
  - Reduction
  - Tailoring
  - Suggestion
- A motive can employ any number of the above techniques

Example – Call Centre

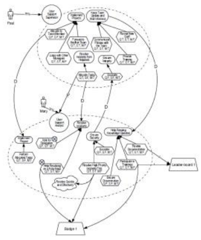
- Here is an example of a call centre modelled using DMML.
- The call centre performs voice analysis and calculates the delta of the customers' anger before and after the call
- Agents receive points for reducing the anger
- Therefore, agents will crave for more angry customers
- This can create ethical issues such as forcing people to do things (wishing for angry customers) that they wouldn't do normally

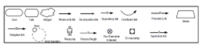




Example – IT Services

- In this case, employees are provided with a leader-board for a task which requires intellectual effort, is quality based, and is difficult to measure and give points to the outcome
- This can create the feeling of unfair points in the employees
- It can even persuade them to decrease quality just to get the points as the system does not acknowledge their efforts

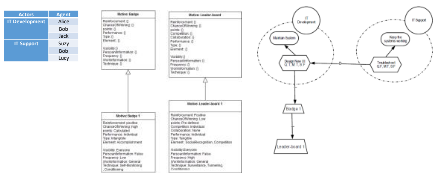




Scenario 1

- In a university, the IT department consists of two teams, IT support and IT development. Employees who are a member of the IT support team are **Suzy, Lucy, and Bob**, also employees who are a member of the IT development team are **Alice, Jack, and Bob**. The IT support is responsible for maintaining and repairing the faulty computer system in the working environment. There have been several reports that the current design does not satisfy users' experience. The management of the IT department tasks the development team with a new design of user interface to increase users' satisfaction level. The university is seeking to provide a collaborative working environment for its employees.
- The IT management decides to use DM to increase motivation and engagement to work in the employees. Therefore, the decide the following plan:
- The support team receives a success badge if they finish tasks within a given time which is decided and set by the project managers based on the difficulty of the tasks and the effort required. For the IT development team, the management decides to implement a leader-board of top user interface designers. When a user interface design is required, each member of the development team is asked to design an interface. The designs will be polled amongst all the employees to select the best design. The designer whom his/her design is selected receives 20 points which can be used to buy extra paid holidays for 100 points each day.

Scenario– 1 Model



DMML Teaching - Slides

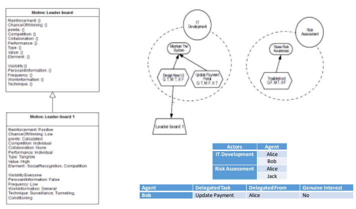
Scenario – 1 Reasoning

- **Conflict of Interest:**
  - The conflict of interest is when an agent has the possibility of hindering something in the environment to gain advantages over other agents. It can happen when there is a competition introduced by the settings of DM on a certain task/goal, and there is a dependency relation between this task/goal and another task/goal. If one agent from the competition can interfere with the dependee task, he/she can cause disturbance in other agents' performance and gain benefit from this. A healthy design of DM should be able to detect such conflict of interest and resolve this issue before introducing the DM to the BIS.

Scenario 2

- An IT department of a university consists of two teams, the development team and the risk assessment team. Employees in the development team are Alice and Bob, and employees in the risk assessment team are Alice and Jack. The development team is tasked with designing a new user interface for the web application of the organisation and updating the payment section for the student portal which has a very firm deadline as the registration date is close and students should be able to pay their fees online. The risk assessment team is tasked with a risk analysis and preparing the report with a very firm deadline.
- Bob and Alice must work on the design task, moreover, Alice must work with Jack in the risk assessment task and prepare the report. The risk assessment report should be prepared on time as it has been marked as high priority by the managers. Alice is running out of time and asks her manager to delegate her part of the updating task to Bob. The manager agrees to this if Bob volunteers to perform the task on Alice's behalf.
- To encourage the employees to come up with high quality designs, the managers have decided to give points to the winner design and put it on a leader-board. Those who remain in the leader-board at the end of year will receive a £500 Amazon voucher as a prize

Scenario– 2 Model



Actors	Agent
IT Development	Alice
	Bob
Risk Assessment	Alice
	Jack

Agent	Delegated Task	Delegated From	Genuine Interest
Bob	Update Payment	Alice	No

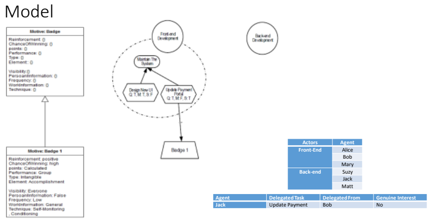
Scenario – 2 Reasoning

- **Bribe for an exchange:**
  - Bribe for an exchange can happen when an agent can allow another agent to win when asking for a favour or ask another agent to let him/her win when being asked to do a favour. Bribe for an exchange can be very unpleasant from a business point of view as in the case of quality oriented tasks, this may reduce the quality since an agent may be assured about the win as a bribe. This is more likely to happen when there is a competition in place, there is a high value reward involved, and a delegation of a task which is out of the scope of the reward is happening. A healthy design of DM should be able to detect the happening likelihood of this issue and introduce preventive measures.

Scenario 3

- In a university, the IT development team consists of two teams, front-end development and back-end development. Employees in front-end development team are Alice, Bob, and Mary, and employees working in the back-end development team are Jack, Matt, and Suzy. The front-end team is tasked with updating the current user interface design, which has caused confusion in how the system should be used. The managers have given this task a high priority and are asking the front-end team to solve the problem and update the interface as soon as possible.
- To increase motivation and engagement in the employees, the managers have decided to give points to each team for their tasks. These points will be used as tokens that can be spent on extra holidays.
- Bob from the front-end development team has called sick and cannot make it to work for a couple of days. To help the front-end team, the managers assign Bob from the back-end team to help in the updating tasks.

Scenario– 3 Model



Actors	Agent
Front-End	Alice
	Bob
	Mary
Back-end	Suzy
	Jack
	Matt

Agent	Delegated Task	Delegated From	Genuine Interest
Jack	Update Payment	Bob	No

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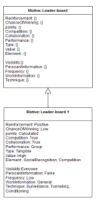
Scenario – 3 Reasoning

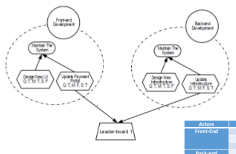
- **Free riding:**
  - Free riding is when a group member performs less than the required share as he/she perceives that other members will do the job. Free riding can increase the tension in group activities and decrease the performance of the group. It is likely to happen when there is a group activity and personal contributions are not captured via DM. In addition, it is more likely to happen if an individual agent has no genuine interest in the goal to be fulfilled. Such as a case where an agent is delegated a task from another group which he/she will not benefit from the gained rewards.

Scenario 4

- In a university, the IT department consists of two teams, front-end development and back-end development. Employees in front-end development team are Alice, Bob, and Mary, and employees working in the back-end development are Jack, Matt, and Suzy. The front-end team is tasked with updating the current user-interface design, which has caused confusion in how the system should be used. The managers have given this task a high priority and are asking the front-end team to solve the problem and update the interface as soon as possible.
- To increase motivation and engagement in the employees, the managers have decided to give points to each team and the top performer teams will appear in a leader-board. At the end of each week, the team with the highest score will receive a token. The tokens can be used at the end of each fiscal year to give a raise to the salaries of the members of the team with the highest tokens. The points are given to the groups and not individual basis.
- Bob calls sick and cannot make it to work for a few days. The managers delegate Bob's tasks to Jack from team 2.

Scenario– 4 Model





Actors	Agent
Front-End	Alice
	Bob
	Mary
Back-end	Suzy
	Jack
	Matt

Agent	Delegated Task	Delegated From	Genuine Interest
Jack	Update Payment	Bob	No

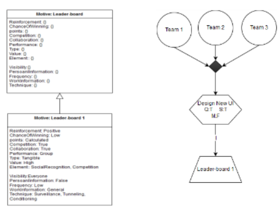
Scenario – 4 Reasoning

- **Sabotage:**
  - Sabotage is when an agent finds an opportunity to hinder the performance of a group to increase the chance of winning for another group. This is very unethical and businesses would not like to create an atmosphere that persuades agents to act in this manner. Sabotage is more likely to happen when there is a group competition in place for a valuable prize. However, circumstances lead the situation to a state where an agent from a competing group is delegated a task which has an impact on the agent's chance of winning the prize. This is very unhealthy and should be detected and resolved prior to the design and implementation of the DM.

Scenario 5

- In the IT department of a university, there are various teams working on UI designs, trying to create interfaces that users find convenient and appealing to use. Different factors play a role in a good design of UI such as response time, appearance, etc. The organisation is looking for the most convenient and user friendly design that the teams can come up with. The UI holds a great value for the organisation as it attracts or repels the clients while using the organisations web site.
- The organisation values collaboration and sharing of information within groups and individuals. They also want to encourage teams to find the best frameworks and apply them to come up with the best UI designs. Therefore, they decide to **gift shares** to the members of **the team** that makes the most effective UIs during the fiscal year by using a leader-board.

Scenario– 5 Model



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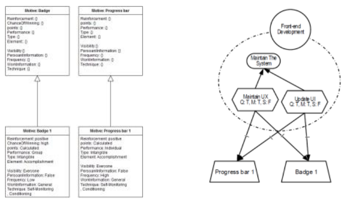
Scenario – 5
Reasoning

- **Secrecy:**
  - Secrecy is when agents find a solution which can aid in achieving the business goals with a higher quality or performance. However, decide to keep it as a secret of their group since it provides them with benefits. This is likely to happen in cases where groups or agents are competing for high value prizes and the sharing of information has lower value or even no value. This will prevent all the other agents and groups from using the found solution and will prevent the organisation from higher performance or quality. A design of DM should be able to detect and prevent secrecy from happening.

Scenario 6

- In the IT Department of a university, the front-end development team is responsible to make sure that the UX is kept at a satisfactory level and update the UI when necessary to address the requirements of the customers. Collaboration of the team members is crucial to the success of the team and failure in a proper communication and collaboration may lead to a dropdown in the final artefact. The UI holds a very important value for the organisation as this is the face of the university in the students' eyes. Therefore, the management wants to decrease the chance of a failure in the design of UI as much as possible.
- In order to encourage collaboration, the organisation tries to reward the front-end development team as a group through badges. For communication and tracking purposes, team members have access to each other's detailed work performance by the use of a progress bar. This can help them schedule the plan and make changes easier if necessary.

Scenario– 6
Model



Scenario – 6
Reasoning

- **Workplace intimidation:**
  - Several circumstances can lead to workplace intimidation and bullying. An example of workplace intimidation is when agents with higher performance group together and put pressure on agents with lower performance. The likelihood of workplace intimidation increases when the agents are compared with each other or they have access to each other's performance, weaknesses, or strengths. A healthy design of DM should consider the probability of happening of work intimidation and provide preventive measures.

8

DMML modelling session - Experts

Participant's Handout

Task 1:

Please read the given scenario carefully and identify the goals and soft-goals of the organisation

Task 2:

- Please read the given scenario carefully and identify the tasks of the organisation
- Please discuss with your peers in the group and identify the characteristics of each task
- Please find as many relations of tasks with other aspects of the environment as possible (you can use the meta-model as a guideline)

Task 3:

- Please read the given scenario and identify the actors of the organisation
- Please identify as many relations between the actors and other aspects of the environment as possible (you can use the meta-model as a guideline)

Task 4:

- Please discuss with your peers in the group and decide motives which you think should be added to the organisation with regards to the provided requirements

Task 5:

- Please discuss with your peers in the group and decide a strategy for introducing Digital Motivation to the organisation with regards to the requirements provided in the scenario.
- You can use the meta-model as a guideline to help in understanding what characteristics are applicable to your motives

GORE modelling session - Experts

Participant's Handout

Task 1:

Please read the given scenario carefully and identify the goals and soft-goals of the organisation

Task 2:

Please read the given scenario carefully and identify the tasks for each actor in the organisation

Task 3:

Please read the given scenario and identify the actors of the organisation

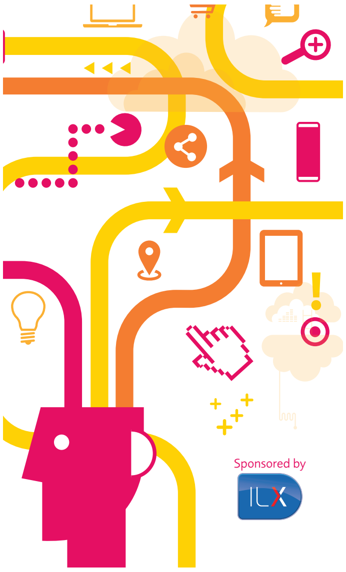
Task 4:

Please discuss with your peers in the group and decide game mechanics which you think should be added to the organisation with regards to the provided requirements

Task 5:

Please discuss with your peers in the group and decide a strategy for introducing Digital Motivation to the organisation with regards to the requirements provided in the scenario.

Introduction to Gamification



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Foreword

How do you motivate and engage a team which is glued to their smartphones? That was the question we set out to answer when exploring the subject of gamification.

With its origins in the computer games industry, game thinking, or rewarding 'players' to solve problems, has become more widely used across different sectors. However, its use within the project management community is still in its infancy.

Through this guide we want to raise awareness of this exciting new trend, highlight the benefits – the effect of incentives such as points for 'players' and badges to showcase achievements – and its application to everyday projects.

If we can make you think of how you could incentivise your team, through gamification, perhaps through their smartphone – then we will consider this project a success.

APM Thames Valley study tour team

ILX Group is delighted to support this brand new series of APM publications. We firmly believe that gamification is an emerging trend that will add real value to the project management profession and, with the help of this guide, more users will be able to benefit.

We have been supporters of gamification for some time now and have developed a number of products to support project professionals in their quest for a professional qualification.

As a leading educational provider, ILX Group recognised the potential benefits of game play very early in its development. In fact, we have been actively using games in our eLearning and classroom courses for some years. The effect has been significant, bringing together learners in a way which wouldn't be achievable using more traditional educational techniques.

ILX Group

Introduction

The concept of gamification and its techniques in non-gaming environments is a fast emerging practice in business. Though in its infancy, the dynamics and techniques of gamification have been found to be easily transferrable from their gaming software origins into the world of commerce.

The use of gamification tools and methods has the potential to benefit project managers from all industries because of their fundamental potential to shape and influence behaviour. It is important for project professionals to fully understand the concept, how it could be applied to projects and the associated benefits or risks, if its transition to project management is to be successful.

This guide builds on the Association for Project Management (APM) Thames Valley branch study tour team's report on gamification and introduces the concept as a tool for project management. The team carried out a yearlong study into this emerging practice, undertook research with industry experts and tested the theories themselves. The report, published in 2012 (APM, 2012), detailed recommendations on utilising gamification within project management.

This guide has been designed to offer project managers an introduction to gamification and provide an insight into its origins, possible uses and benefits within the profession.

What is gamification?

Gamification originates from the computer games industry and is the use of game thinking and game mechanics in a non-game context in order to engage users, solve problems and drive behaviour. When used in a business environment, it is the

Introduction

process of integrating game dynamics into a website, business service, online community, content portal or marketing campaign to initiate participation and promote engagement. On a basic level gamification techniques tap into and influence peoples' natural desires for competition, achievement, recognition and self-expression.

Software companies introduced the same kind of concepts into work life that were being developed within their games. They found that their employees responded positively to being awarded 'badges' dependent on their performance or level of effort. Gamification appears to be making the leap from game-play to the workplace at a great pace. A growing number of organisations are adopting gaming techniques and game-style rewards in order to motivate and incentivise employees and customers (Gartner, 2011).

Within the last three years, gamification has started making the transition into mainstream industry as a tool used to increase the engagement and motivation of a workforce. This transition has been facilitated by the increased availability of appropriate technology and connectivity, such as smartphones and tablets, which can support a gamification environment.

Further detail on recognition and reward can be found in the Game mechanics section on page 13.

Who uses gamification?

The basic principles of gamification have existed for over a decade in areas such as internet consumer engagement applications (apps), frequent flyer cards, loyalty schemes and healthcare fitness programmes. Many companies have introduced gamified schemes in order to increase customer engagement or more recently employee engagement. These schemes motivate the customer or user to continue buying or using a product or engage the user's interest and increase motivation.

Companies including Starbucks, Nike, eBay, Salesforce and Badgeville are among the organisations which have found success with the concept of employing game-like activities to improve business and customer interaction. Lee Sheldon, a gamer, game designer and assistant professor at Indiana University, USA, believes that managers may have to rethink how best to engage the next generation entering the mainstream workforce (Sheldon, 2010). However, the benefits of gamification are not necessarily confined to the next generation; they are equally applicable to a person of any age, gender or background.

Reviewing education and the courses establishments offer is a good indicator of how gamification is viewed and being utilised in business. Several UK and US universities offer courses encompassing gamification, ranging from one-off courses to a module on a master's degree.

Gamification theory

When defining the term gamification, there are a number of different interpretations of the method, situations and context in which gamification should or could be implemented. Some people refer only to gamification as used within its originating software industry. Others argue that gamification can be used as a sales and marketing tool to capture the interaction of an online customer base. Increasingly, however, there are a number of references to gamification as a project management or employee engagement tool.

Put at its simplest, gamification is the use of game design elements, game thinking and game mechanics to enhance non-game contexts.

This is the main function that gamification could provide – enhancing a situation through the use of gaming mechanics, the benefits of which include:

- increased engagement;
- higher motivation levels;
- increased interaction with the user (customer or employee);
- greater loyalty.

This is important in project management terms, as one of a project manager's main objectives should be to increase the engagement and motivation within their team, in order to improve performance and strengthen working relationships. These, in turn, result in a stronger and more effective project team and performance.

Within project management there are many different models to help us understand how people work. As managers of people it is very important to have a good knowledge of these, how best to use them, and how your behaviour impacts on the people you work with.

In the report, the APM study group considered some popular behavioural models and applied gamification to understand the outcomes, including Maslow's Hierarchy

of Needs which identified that humans have a number of needs that we aim to fulfil during our lives and gamification could be utilised to promote and achieve the top three levels. Dan Pink's *Drive: the surprising truth about what motivates us* (Pink, 2011) correlates the hierarchy of needs with the basic principles of gamification and explains that the deficiency needs in the model are satisfied by a long-term interaction with the gamification method, where people can attain status, social cohesion and reputation. The reason gamification is so successful is due to the rewards provided in the self-actualisation pinnacle of the Maslow model. By playing the same 'game' social cohesion is created, and by using rewards and feedback, self-esteem and a sense of achievement are promoted.

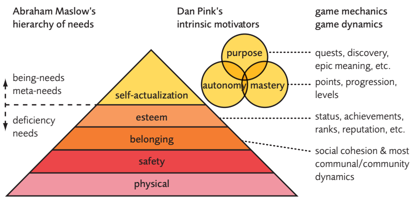


Figure 1 Maslow/Pink model – created by Michael Wu PhD, chief scientist, Lithium Technology (Wu, 2011)

The APM Thames Valley branch study tour undertook a survey of 95 project professionals as part of its research and the results support the Maslow/Pink model.

Respondents were asked to describe their own personal motivating factors. The majority of peoples' motivating factors fell within the need for esteem and self-actualisation (APM, 2012).

The seven deadly sins have been applied to gamification by Wang (2011) where for example gluttony relates to people with the desire to accumulate, acquire and contribute; greed taps in to the desire for power and status, and envy fuels a need to desire what others have (relating to the success of others and transparency).

Gamification and neural activity

While trying to gain an understanding of the behaviours and expected responses of an individual or team, it can also be important to consider what is happening in the brain that affects people's behaviour. There has been significant study into the neural activity inside the brain when a person is undertaking exciting and addictive tasks and while there has been no specific study into the impact of gamification within the brain, it could be assumed that the effect is similar to that of gaming, gambling and other competitive activities which release specific chemicals to create feelings of excitement, euphoria and pleasure. It has even been hypothesised that gamification aims to activate the brain's natural reward system through the release of a chemical known as dopamine, giving a feeling of satisfaction and happiness. By tapping into a person's neural system and rewarding them, this activation should then fuel the motivation to continue and become further engaged in the activity.

Why are people interested in gamification?

Gamification taps into the basic needs and desires of individuals; impulses which often revolve around competition, status and achievement, and in some cases even a form of self-expression. These attributes are embodied in everyone, at differing degrees, and it is this which gives gamification the potential to be such an effective tool within the project team and wider workplace.

Software provider Bunchball has described the attraction and pull of gamification in a very illustrative way: two people playing monopoly every day for a week would get bored very quickly, but if you add in another element – capturing statistics – it starts to take on another dimension. How many times each person won, which properties were most profitable, how much money each player accumulated; all these elements create another level to the game (Bunchball, 2010). The statistics become the game and people want to outplay each other.

It is the excitement generated by the collection of a number of statistics, and the use of those statistics, that can encourage people to perform tasks they would ordinarily consider uninteresting, repetitive or strenuous. It is this application that has created a high level of interest within the business world.

Game mechanics

There are four main areas under the gamification banner. The understanding and correct application of these four areas together produce an environment in which engagement, loyalty and motivation are able to flourish.

The four areas are:

- points – something for 'players' to earn;
- rewards – something for 'players' to spend their earned points on;
- badges – something to show peers the achievements 'players' have unlocked;
- leader boards – a method of gaining some real-time feedback which is visible to everyone.

It is important to understand the distinctions between these areas before introducing gamification within a project team, the details of which are explored below.

Points

Points provide the main method of currency within a gamified system. In order to earn points, team members have to complete tasks. One of the reasons gamification works so well is that the natural human psyche urges people to collect resources - the more resources a person has, the greater their status.

Points can be a great way to virtually move up in an organisation and demonstrate to other people within the team and organisation that a person is remaining on track (Mashable.com, 2011).

Points work as a highly-effective motivator and can be used to reward users, with different categories of points being used to drive different behaviours within the same site or application. These are not only used as status indicators, in a gamified

environment they can be used to 'buy' items or services as determined by the project manager or organisation.

In project management terms, earning points can also be a good way for project managers to track team performance or direct behaviours. With a points system, project managers have the opportunity to incentivise tasks according to the importance of specific activities at any given time in a project, and to recognise good performance within the team. By monitoring the points earned within the team, project managers have an important tool which also acts as an early warning system in identifying and resolving any poor performance or other issues.

Rewards

When a 'player' earns points and completes challenges in a game there is a reward and a reason for having done the task. This should also be true within the workplace. Purist gamification theory states that, as in a game, the reward should be non-monetary; the earning of points is a reward in itself. However, in the workplace, some organisations set up reward portals from which employees can purchase a variety of rewards ranging from:

- team dinner;
- vouchers for a family day out;
- vouchers for high street stores;
- lunch with directors;
- company private venture funding;
- a role on a top secret future project.

To increase the chances of people continuing to wish to spend their points, and therefore making them more likely to perform tasks and earn further points, it is very important that the rewards available are regularly refreshed to include new opportunities.

Badges

A key human desire that impacts on the workplace is the desire to show competency. Usually the only place to do this is through the standard organisational hierarchy, however gamification provides a method for displaying a person's competencies so that everyone is able to recognise an individual's ability. It works in a similar way to the armed forces, where badges showing training undertaken, competency and responsibility are displayed on uniforms; 'players' within gamification can also earn badges which are seen by the whole organisation and peer groups.

Badges symbolise an individual's ability to perform and can be permanently attached to a player's profile, serving as a visible record of achievement (Playgen.com, 2012). They are often seen as long-term achievements, and are a determining factor for maintaining the challenge within a gaming system.

In a project management environment, challenges could be based on tracking important project tasks and rewarding the team, or individuals within the team, for reaching those milestones with points, badges and recognition (Bunchball, 2010).

Leader boards

The recognition that follows the collection of points and badges forms an important component of gamification. Such recognition can be within the project team, peer group or could extend to senior management. One method of achieving this recognition is through leader boards. By accumulating points or recognition and seeing these on a leader board, individuals can advance 'through the ranks' and be recognised by their teammates (Mashable.com, 2010).

This public display of achievement can help gentle, healthy workplace competition and aid team development as it feeds the human social need to compare oneself with friends and peers as well as experts alike.

In a workplace that utilises gamification, being at the top of a leader board feeds an individual's need for recognition, social status and self-worth. Being lower down on the board has the effect of encouraging people to improve their placing. It is this element of competition that drives people, satisfies their need for challenge and reward, and motivates the workforce through target setting.

Equally, instant feedback can create a sense of achievement for those motivated by progression, and not external competition. Here, the leader board can achieve results where a participant sees their progress over time.

To some members of the team, the element of social recognition may be more important than the tangible rewards. Individuals looking for career development may benefit more from the recognition gained through gamification. Colleagues are also able to track each other's progress and publicly recognise well-executed tasks, while managers have the opportunity to look at a team's performance and provide praise and useful feedback (Mashable.com, 2011).

Gamification in the workplace

Some team members embrace change easily, while others may be a little more reluctant to accept something new. The best way of introducing a new idea is to start with something that is easy to use, which is entertaining and fun. This generates a level of interest in people that will make them want to join and compete. The implementation must enable people to see that the system is a positive, rewarding step forward, and one which will have a positive impact on daily working life. It is also important to have a visible longer-term plan in terms of profiling and future career development.

An important consideration in facilitating the acceptance of gamification is the leadership the project manager demonstrates towards the method. If the project manager can communicate convincingly that the experience will be a rewarding one, which challenges and invigorates individuals and the team as a whole, the experience has a higher chance of being successful. There must be a clear observable benefit to both the organisation and the individual taking part, and it is the implementing project manager's responsibility to convey this in order to foster initial engagement. Once the team has bought in to the concept and participants have reached a critical mass, a sustained level of gamification can be achieved.

How could gamification be applied to project management?

Projects and games share some noticeable traits. Games are usually driven by coherent goals, well-defined player roles and meaningful metrics in order to provide feedback on progression. Similarly, well-managed projects are guided by cogent objectives, team members have delineated roles and intelligent metrics that are employed to measure progress. The significant difference between the two lies in gaming feedback, which is transparent, instantaneous and public (Project Management Hut, 2011).

Gamification encompasses many elements that could be utilised successfully within a project management environment to create fun, motivate staff and increase productivity within project teams.

The principles of gamification are based around the ability to help create and sustain relationships between the user (employee) and a product (the project). The use of engaging and entertaining games/activities as an addition to the working environment are designed to resonate and entice both gamers and those not interested in typical gaming practices (Playgen.com, 2012).

By engaging multiple users in a product, a community is created. Allowing interaction within the community creates a societal attraction – one of the factors that encourage a user to return (Bacon, 2012). Gamification has the potential to create a sense of community within a project or organisation, which in turn should inspire engaged users to contribute at a much higher level due to camaraderie and an increased sense of loyalty.

Individual project team members would be encouraged by the accountable goals and the clear recognition and reward policy. Gamification could be an important tool to assist the project manager in understanding what the team has to do, as well as enabling the team to fully understand the manager's expectations and requirements.

Gamification in itself does not add any measurable value to a project or organisation. It is in peoples' enhanced commitment and engagement with a project and through the development of key emotions such as loyalty, pride, a strong work ethic and willingness to win, that the real benefits of gaming can be understood.

Adopting gamification techniques

The use of gamification in the workplace should only be implemented after careful consideration of the possible implications. Gamification within a working environment is very different to gamification with a consumer, online or internet community. It is therefore necessary to fully understand the positives and negatives of the gamification process, and it is particularly important to realise that it is not a solution in itself, but a tool that can have both positive and negative effects on the workforce.

The benefits of gamification techniques

In the workplace, gamification could have a positive impact on individuals and project teams in a number of ways including:

- higher motivation levels;
- greater productivity levels;
- an increase in feelings of shared goals;
- increased acceptance of repetitive, less exciting tasks;
- greater individual and team achievements;
- providing a timely understanding of team performance;
- data collection that can assist project managers in understanding the skills base within the project team;
- stronger commitment to the project/organisation;
- greater transparency;
- clearer accountability;
- increased staff retention rates;
- immediate and ongoing feedback.

The risks of gamification techniques

Introducing new systems into an organisation could also have a negative impact. Possible risks include:

- alienating some members of the project team/organisation;
- the system may not work for all areas and levels of the team;
- where there are winners there are losers – what effect will this have on the team?
- some employees may react negatively to being measured;
- applying gamification to every aspect of the workplace may cause a lack of focus and prevent interest in the engaging aspects it can provide;
- points and badges may become less exclusive as time goes on, leading to a lack of interest in the initiative;
- work could be de-valued if the behaviours enhanced are not well considered and not aligned to desired work behaviours;
- healthy competition could turn into destructive competition, creating divides and preventing a team culture;
- cheating could lead to demotivation and dissatisfaction;
- gamification may alienate older members of the team who are unsure and unfamiliar with the terminology (this could apply equally to any team member regardless of their age).

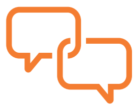
Gamification good practice

Experts agree on some fundamental rules for the successful implementation of gamification which specify that user participation should be voluntary and the system should be adapted to the organisation. A variety of levels should be introduced which increase in difficulty and the feedback and data generated from the platform should be used to improve the platform.

The most common pitfalls identified by experts in conversations with the APM study group were:

- tools not fitted to users;
- lack of a cheat-proof concept;
- lack of monitoring;
- restricted usability;
- absence of intrinsic meaning and rewards;
- social impact not accounted for;
- no increasing challenge.

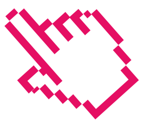
It is also key to remember that gamification is not a solution to fundamental issues within a project team or organisation. Where issues are present, these would need to be considered and addressed before the introduction of the gamification tool in order for it to stand a chance of success. Successful gamification lies in a carefully planned and organised setting, reviewed and adapted according to feedback from users.

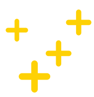


The APM Thames Valley branch study tour research led the group to construct these good practice dos and don'ts for gamification in project management.

Do . . .

- Align the system with your company vision, identity and brand.
- Integrate the gamification into the brand and the look and feel of the company.
- Identify the key existing behaviours you wish to enhance or change.
- Design the system to your company's specific needs.
- Collect data and use it as feedback to improve the system.
- Provide data to users to enable them to analyse their own performance.
- Keep it simple – the fewer clicks the better.
- Make it enjoyable – employees will buy into it more easily if it is fun.
- Trial your system with a user group.
- Make it optional and trust you will attract more users – having to use the system will have a negative effect on those who are less interested in taking part.
- Ensure the badge is worth earning through either social or professional recognition.
- Ensure the points are worth getting by making it a challenge to earn them.
- Make it shareable – to entice sharing of information between users.
- Contextualise the system – it makes it meaningful.
- Be transparent about how the system works.
- Look into how the system could be broken – to highlight unintended consequences.
- Periodically review the points system – users will lose interest if the top of the board is unreachable (or too easy).





Don't . . .

- Trust the system can look after itself – a system that is not adapted will lose users.
- Go for really low-tech systems – the technology is there to help administer and adapt the system.
- Assume that the system will take off by itself – project managers need to work to sell the concept.
- Use the term gamification with those organisational members who may have problems with the gaming concept – consider using 'incentive' or 'motivational and engagement tool' instead.
- Make the system inaccessible for people – ensure all users have appropriate access through the right level of technology.
- Increase admin – ensure it either saves time or the enjoyment outweighs the number of clicks.
- Alienate groups within the potential user base – identify what motivates them and work it into the model.
- Reward undesirable behaviours – test the system for any loopholes.
- Get disheartened – all new systems have teething problems and take time to become established and accepted.
- Let the system get outdated – a good system is always improving.
- Punish lower performers.

Gamification case studies

Cranfield University

Cranfield uses gamification in a complex, highly interactive project simulation to improve project professionals' performance in a protective environment that allows them to subsequently analyse their performance.

Participants have to not only manage project planning and control, but also manage stakeholders. Project simulations that can be used include managing a mining project in South America, building a football stadium in the UK and merging two banks.

The simulation allows users to earn virtual money and the performance management extends to losing your job due to non-performance. The simulations force users to work under the pressure of unforeseen events and manage projects under high levels of stress. Most students learn from the opportunity to try and commit errors in a simulated/safe environment.

The Cranfield simulation and use of gamification creates an instant appreciation of the complexity of projects, and human interaction. The feedback that is generated allows participants to modify their behaviour and their actions back in the real-time world, but it is easy to make the jump to be able to see how the same data and feedback could help in a classic project in a live environment.

giffgaff

giffgaff is a UK mobile phone network that operates a mobile virtual network using O2's infrastructure. It invites its members to participate in some aspects of its operation, such as sales, marketing and member (customer) service with members being rewarded through 'payback' remuneration. giffgaff is a young, entrepreneurial company with a dynamic atmosphere and impressive growth curve. The community is engaged in projects that develop concepts generated from the ideas board, including:

- re-launching its knowledge base;
- payback for members and kudos points for involvement in projects;
- development of the company 'route master' – a road map of projects that is shared visually with staff and members;
- managing giffgaff's re-branding project with the community as stakeholders;
- building the brand values within the company.

The route master provides a visual picture/leader board for the office, showing how projects contribute to the company strategy and vision, prioritising ideas and future projects as well as tracking the projects through to completion via an interactive board on the wall.

ILX Group

ILX Group provides professional business technology-led learning and consulting services. It uses gamification in its services and one particular example is its snakes and ladders game. Designed and built by ILX Groups's own development team, this engaging game brings together learners in a fun way. The game has been designed to be subject independent allowing ILX Group to use it across its entire training portfolio as a revision tool. It comes into its own in the classroom, where learners form teams to play head to head.

This has helped improve the learning engagement of courses; increase the learning experience and provided a deeper understanding into the learning methodologies. The use of animation and audio along with a 'big screen' experience help break the ice and bring learners together to share ideas and broaden their understanding. The feedback from customers has been incredibly positive with comments ranging from "the most innovating learning experience I have ever had" to "I literally cannot wait to tell my work colleagues how much fun gamification is!"

To build on this success, ILX Group is committed to developing further gamification ideas and concepts which will extend the reach to a wider audience and promote the most innovative learning methods on a global basis. ILX Group aims to further capitalise on the real benefits to its customers and work to enhance their practical, applied and fun learning.

SAP AG

Business software maker SAP uses gamification in a large online community of SAP professionals.

When a customer or partner asks a question on the SAP Community Network (SCN), both SAP employees and SAP experts can provide answers and guidance. The member who posted the original question can then reward other members for their answers based on how useful the response was for them. It is also used for blogging and editing wiki-documents such as FAQs, for which members can accrue more points.

These points indicate a member's competence with the technology and these have even taken off outside the SCN as a professional rating, particularly for independent consultants. For some members this has led to more and more interesting projects or jobs.

UK Department for Work and Pensions

The Department for Work and Pensions (DWP) invested just over £100,000 to set up its own gamification system to develop internal innovations. Within the first year of operation a £20m benefit was generated from successful ideas developed through the platform (Cotterill, 2012).

The DWP platform encourages the development of internal innovations through a stock exchange system with a virtual currency. Users propose their ideas on the platform and 'shares' can be bought by fellow employees if they consider the idea to have high potential. The platform encourages the sharing of ideas, and it ensures the quality of content by giving credit to marketable ideas.

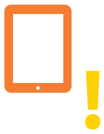
Team work is promoted within the platform by using online problem solving between users sharing ideas and solutions to develop the ideas. This creates a sense of community, and drives user engagement.

The DWP believes that this tool has created a significant return on investment within its first year through the implementation of creative ideas, as well as creating a more stimulating environment to work in and facilitating the discovery of previously untapped potential.

The future of gamification

Gamification has been called a buzzword and fad by some of its critics; however elements of gamification have been used for a long time including loyalty schemes and happy hours in bars and restaurants.

Some statistics show that the usage of gamification in an organisation can decrease over time, though this can be due to a number of factors including gamification planning and implementation. If the difficulty or challenge levels do not increase, employees get bored and stop engaging and interacting with the system. Unless organisations analyse the data generated and adapt the system accordingly then it risks failure.



The majority of gamification programmes currently focus on the end goal rather than the journey to reach the end goal. Gamers traditionally find the most rewarding goal is devising the strategy to achieve that goal; stop the opposing team or evade traps, not simply holding the badge/reward. Therefore if gamification is to continue its path from the gaming industry into the modern workplace, careful consideration must be given to finding a way for people to experience some sort of narrative on their way to an end goal.

To ensure gamification is not just a trend, organisations need to ensure they are using well-designed games. Simply introducing or adding a game application does not guarantee results (or the right results). To ensure a high level of engagement, as well as the system being fun and relevant, the game design needs to be well researched to ensure it has the right approach to improve virtually any aspect of a business.

According to a 2011 Gartner research report it is estimated that by 2015, more than 50 per cent of organisations in the US, which manage an innovation process, will 'gamify' those processes. The research findings are backed up by companies such as

Cisco, Oracle and SAP, which are all reported to be developing gamification to increase engagement. This commitment from blue chip companies suggests there is much more to learn from early gamification successes and failures, and that thorough investigation of this will reap benefits in the future once the effects are fully understood.

Gamification is an interesting and exciting prospect within project management. One of the main interest points is the understanding, interaction and manipulation of human behaviours within project teams, in order to achieve the project manager's desired outcomes and results. Project managers must carefully consider which behaviours need to be manipulated or changed, why these should change and how the gamification tool can help achieve this. Until the detail has been considered and thought has been given to the impact on, and reaction of, the project team, the implementation of any form of gamification should not proceed as the risk for team destabilisation and unintentional behavioural changes remains a real, and potentially damaging, possibility.

Gamification has the potential to be a useful and valuable tool in project management. Used in the right hands and implemented in the right way, examples in the business world have shown that a 'gamified' team can be a happier, more motivated, engaged and cohesive team.

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Further reading and useful resources

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Appendix

Gamification and the *APM Body of Knowledge* sections

Looking at gamification in relation to the *APM Body of Knowledge* (BoK) sections helps to identify how this emerging concept could link in with project management and be applied within a project team. The following table illustrates how gamification can be applied to just some of the aspects of project management and the different ways gamification can be implemented.

APM BoK (6th edn) section	How could gamification apply?
Context – governance	
1.1.1 Project management	Tasks are defined and allocated and the use of gamification tools allows for planning, scheduling, managing and motivating the project team.
1.1.5 Knowledge management	Sustained growth of knowledge databases such as wikis can be strengthened using gamification platforms.
1.1.6 Life cycle	Tools can be customised for stages of the project life cycle to keep metrics and incentives relevant.
1.1.7 Success factors and maturity	Allows clear goals and success factors to be set and measured up to completion.

Context – setting	
1.2.1 Environment	Simulating business environments in a gamified manner can improve the understanding of the environment. This also allows the modelling of potential effects of changes by employees and employers in a safe manner.
People – interpersonal skills	
2.1.1 Communication	Clear project objectives and goals given. Project performance information is available for all and instant feedback is available for employees and management.
2.1.2 Conflict management	Assists in reducing conflict through the introduction of clear and concise goals. Rewards are transparent and can visibly be awarded for good performance. These aspects will reduce the occurrence of conflict.
2.1.5 Leadership	Enables project visions and direction to be communicated and helps project team alignment through incentives.
2.1.6 Negotiation	Negotiation skills can be practiced and effective methods rewarded and reinforced.

2.1.7 Teamwork	Increases team motivation and encourages competition within the team/with other teams. Working toward clearly defined goals helps to build a cohesive team.
People – professionalism	
2.2.1 Communities of practice	Communities can be formed utilising the communication tools available within a gamification platform. Effective cooperation, delegation and professional development can occur within these structured environments.
2.2.4 Learning and development	Helps individuals to build personal profiles and provides an incentive to fill competency gaps with relevant training.
Delivery – integrative management	
3.1.1 Business case	Enables creation of business cases collaboratively, encouraging innovation and creativity as well as reducing individual workloads. Can improve stakeholder buy-in due to the considered preparation process.
3.1.3 Information management	Provides project teams with instant status updates and gives recognition to top performers. Information is easily accessible.

Appendix

3.1.4 Organisation	Team members can increase their profile and display their competence on the project, while being able to demonstrate their responsibility and accountability.
3.1.6 Stakeholder management	Encourages stakeholder buy-in and interaction with sponsors. Information can be flowed easily to all parties.

Delivery – financial and cost management

3.4.1 Budgeting and cost control	Assessing current performance versus budget within gamification enables greater understanding of how individual contributions affect project budget levels, potentially enabling improvements in spending behaviour.
3.4.2 Funding	Enables quicker identification and greater understanding of over or under funding of areas within a project.

Delivery – risk management

3.5.2 Risk techniques	Differing techniques for risk reduction and mitigation can be compared with ideas for improvement being rewarded.

Delivery – quality management

3.6.1 P3 assurance	Relevant performance statistics can be viewed via the system dashboard, enabling stakeholders to assess current time, costs and scheduling of the project compared to the baseline.

Delivery – resource management

3.7.1 Contract	Through the implementation of a gamified profile, members of an organisation can apply for and be selected for a new role/project based on their badges, points or competencies.
3.7.3 Procurement	Effective procurement can be gamified to encourage employees to undertake established best practice procedures when procuring supplies for a project.

Interfaces

4.2 Health and safety	Incentives can be used to increase the importance of health and safety activities.
4.3 Human resource management	Enables a business to recruit the right people to project teams, helps retain the right people, allows rewards when necessary and helps to develop and train people.

4.5 Security	Information on industry/company mandated security requirements can be disseminated and reinforced through a gamification platform.
4.6 Sustainability	Employee behaviour can be monitored and rewarded using points, badges and recognition. Significant changes in employee behaviour can be instigated.

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Digital Motivation Modelling Language (DMML)

April 6, 2017

1 Introduction

In previous studies [1, 2, 3], we have tried to understand digital motivation in details and identify concepts and constituents that shape it. As a result, thematic maps related to important aspects of the BIS and DM which have an impact on the design of DM were proposed. These thematic mappings provide critical focus on constituents necessary for modelling motivation requirements in a BIS, which paves the way for a systematic approach towards designing and implementation of DM. Since an ad-hoc design and implementation of DM into a BIS may fail to achieve its design goals and have detrimental side effects, a systematic approach towards its design and implementation may help reducing the risks.

One advantage of a systematic design and implementation of DM into a BIS is the consistency in eliciting stakeholders motivation requirements. This is accomplished by providing the aspects of BIS and DM that stakeholders find important and believe have an impact on their perception of the design of DM for the BIS. Moreover, a rigorous systematic approach and a motivation model can enable analysing situations which are not possible or difficult to analyse in more complex BISs. Utilising an expert system and a recommender system can enable automation of the analysis phase if the need is sensed. Despite the advantages of having a rigorous modelling methodology, the literature in the field of DM lacks a domain specific modelling language that considers the business goals of the BIS and users motivation requirements, which leads to the ad-hoc design approaches.

Following extensive literature study on the relevant fields of digital motivation and various empirical studies, in addition to the technical aspects of DM, this research advocates the consideration of organisational structure and social interactions in a BIS. Thus, this study aims at building a framework and modelling language that can describe the socio-technical structure of a BIS and build on that I order to enhance it to enable a better understanding of DM and its introduction to a BIS. Goal oriented modelling languages provide us

with some of the social and technical concepts necessary to model DM and the business environment it is being applied to. Hence, this research builds on top of a goal oriented modelling language and extends it in a manner that can help achieving a more acceptable design of DM amongst its social actors.

This modelling language, Digital Motivation Modelling Language (DMML), enables a systematic design and implementation of DM and paves the way for automated analysis using the models drawn using DMML. DMML consists of various fragments. First is a meta-model describing all the constituents necessary for a systematic design of DM and the relations amongst the constituents. Second is a formal specification describing the language in the form of mathematics. Next is a graphical representation of the constituents and relations amongst them described in the meta-model and the formal specification. The rest of this chapter is structured as follows. First section tries to provide a holistic understanding of DMML, introducing modelling constituents and their relations that is followed by the formal specification of DMML in mathematical form. In the next section, the meta-model for DMML is presented which provides an abstract understanding of the modelling language. In the fourth section, graphical representations for the constituents and the relations are presented which enables drawing of a model for a system-as-is or a system-to-be. Finally, in the last section, the modelling language is used to analyse various motivational requirements in different cases that DMML can help detect conflicts and issues which were not possible or were difficult to detect prior to the use of DMML.

2 DMML: Digital Motivation Modelling Language

DMML aims at helping a BIS to engineer motivation requirements. The goal of DMML is to provide a DM for BISs aligned with the business goals, workplace culture, and workforce preferences. To achieve

this goal, DMML needs information from the working environment in the BIS and the motives being introduced to this environment. DMML can model the system-as-is in addition to system-to-be, for separate reasons. Modelling the system-as-is provides the ability to analyse the current situation of a BIS for any incompatibility of the DM implemented in the BIS. In addition, modelling the system-to-be enables analysing the context and the situation of a BIS and provide it with possible solutions which could aid the business achieve its goals in terms of increasing motivation and engagement of the workforce.

2.1 Modelling constituents and relations

DMML divides the modelling constituents into two distinctive categories; BIS environment and its relations and motives being added to the BIS and their relations. The final model drawn using DMML ties these two parts with each other by binding the relations between the motives and the constituents of the environment and enables a holistic view of the DM. The description of the two parts is as follows:

2.1.1 Environment

The working environment of a BIS is one of the main aspects for the engineering of motivation. It carries various types of information which are needed for engineering the process of introducing digital motivation to a BIS. From the perspective of DM, there are several constituents and their relations that shape the environment in a BIS. These constituents and the relationships are described as follows:

Actors An actor can be defined as an active entity which tries to achieve specific set of goals via performing certain tasks. Actor does not refer to any specific person but positions that people can occupy in order to fulfil those goals through the specified tasks. Actors shape organisational structure and define how each performer of an actor should interact with other actors. Addition of DM to a BIS may influence how people in the environment interact with each other, hence, availability of the information regarding the actors prior to the design and implementation holds a great value.

Values Values refer to the cultural and environmental values of the BIS. The use of DM can preach various values based on its design. These values could range from encouraging competition between the workforce to collaboration. It can seek employee satisfaction or look for highest performance possible. All these can define what the settings of proposed DM should be. Therefore, knowing the values of the environment will help in aligning the design of DM with the cultural and environmental values of the BIS.

Tasks A task can be defined as a set of actions that help achieving certain goals by providing instructions. Tasks are the main connection point between DM. Three aspects of a task define the setting of a motive being added to the BIS. These aspects are measurability, meaning if the outcome of the tasks can be quantified as numbers, subjectivity, meaning whether the decision about the performance of the outcome is subject to human interpretations, and lastly, quality orientation, meaning if the task requires intellectual effort from the employees and quality of the tasks are important or the tasks do not require a great deal of intellectual effort and are focused on quantity.

It is important to know whether the outcome of a task is measurable in numbers before assigning a motive to the task. Depending on the motive being added, information regarding the performance of an employee on a task may be used. Depending on what the motive does with the information, employees may find the measurability of the outcome a crucial factor in acceptability of the introduced motive. Especially if employees are interested in what motives offer.

Next important aspect of the task a motive is being added to is whether there is a subjective opinion on the performance of the

employee. The design of a motive being added to this task should be aligned with the subjectivity of the outcome. Some settings are not compatible with subjective outcomes and may hinder the goal of motivating employees.

Lastly, it should be known to the designer whether that task requires quality and creativity. Various settings of motives are compatible with tasks that do not rely on intellectual effort of the employees and various others are compatible with ones that require creativity and intellectual effort. The critical point is to assign a compatible setting to tasks. Failure in following this may result in a decrease in the quality of the outcome or demotivating the employees at the end.

Agents Agents refer to the actual employees in the BIS who play as actors and perform the tasks to fulfil the goals. Agents are amongst the most important aspects of the BIS as their preferences on the design of the DM defines the possibility of the DM being successful. Eliciting the agents preferences on various settings of DM is a challenging task on its own as the number of agents may be large and no one preference on the settings of the DM may be shared amongst the agents.

To address this challenge, this research proposed the use of personas. Personas are fictional characters that represent a group of agents which have similar preferences and requirements. The needs, preferences, and requirements of the agents a persona represents are not necessarily exactly the same, however, they share a considerable proportion of the preferences. The personas should provide the designers with information regarding agents preferences on five different aspects with regards to DM; incentives, performance and feedback, privacy, goal setting, and collaboration nature.

- Incentives Incentives refers to the preferences of the agents with regards to the reward they receive by means of DM. There are four characteristics of an incentive which agents may find relevant to their preferences about DM. One is whether the

reward is on the quality of the outcome or on the quantity. Depending on the tasks and personalities, agents may have different preferences on this aspect of an incentive. Some may find it appealing if the incentivisation is on the quality of their outcomes. Some others may argue that measurement of the quality may be difficult and biased, therefore, they may prefer an incentivisation based on the quantity of outcomes. Another characteristic is the availability of the incentive. Various agents may have different opinions. Some may prefer to know exactly what incentives are available for them, and did not like the idea of having hidden gems in their working environment. Some others embraced the idea of having the element of surprise in the workplace and found it to be motivating. Next characteristic is the value of the incentive provided. This characteristic is tied with the last one that is the chance of winning. Some agents may prefer incentives high in value, even if it means lower chance of winning the prize. They may not find low value incentives very appealing. On the other hand, some other agents may find a higher chance of winning more appealing, even though it may mean a lower value prize.

- Performance and feedback

  There are two aspects of the performance and feedback report that DM provides for the agents. One is the frequency of the report, and the other is the manner they were generated. DM can provide the agents with reports regarding their actual performance, e.g., points received after finishing a specific task, or feedback regarding their performance over a certain period. Various agents may have different opinions on what the frequency of the reports should be. With regards to the performance of the agents, some may like to have real-time reporting of their points achieved, and some may prefer longer intervals such as at the end of a day or a week. For the feedback, agents may have various opinions as some may find a lower interval encouraging and helpful, enabling them to iden-

  tify their weaknesses and strengths sooner, some others may find it a source of pressure and prefer a longer interval for the feedback. In addition to the frequency of the reports, agents may have different views on how they prefer the feedback to be generated. DM uses software and can provide feedback following specific algorithms. Although some users liked this feature as a computer and algorithm cannot have bias towards any specific agent, some agents may find this distressing as a computer cannot consider contextual situations.

- Privacy

  Privacy could be considered the main concern of the agents with regards to DM. DM relies on capturing information from agents, processing it, and providing the report to specific audience. Various agents may have different views on who the audience should be and what type of information is being available to the audience. Depending on the type of information being provided, agents may differ in their preferences. Some may find it motivating to have the information available to everyone in the working environment, some others may opt for a more conservative measure and only prefer to provide the information available to those who they find relevant. Some others may choose more strict setting and provide the information only to their managers. At the end, some other agents may decide to provide some information only to themselves as a self-monitoring mechanism and even do not like their managers to have access to their information. This type of measure is usually taken for detailed information which agents find personal such as their detailed progress on tasks.

- Goal setting

  One strategy that a DM setting can follow is goal setting, that is breaking down the tasks for agents into smaller ones and provide them with the steps necessary to achieve their goals. In addition to providing the steps for the agents, goal setting can provide a progress bar towards the goal by tracking the performance of the sub-tasks, helping others plan their tasks. Agents can have different views on goal setting from two aspects. First aspect is whether they have control over the settings, and the second aspect is whether it is a compulsory feature and they must participate.

Some agents find having the goal setting feature helpful and useful in the environment. There could be various reasons behind this, such as being assured that the steps will result in success, or even being able to plan based on the provided progress bar. However, not every agent may find being told how to perform the tasks motivating and encouraging. Thus, providing the ability to choose and set the steps could relief these proportion of the agents, keeping the progress bar in place. This should be considered that a proportion of agents may find this feature very intrusive from both perspectives, forcing them to work like a robot by being told the exact steps needed for their tasks, and being monitored by means of the progress bar. Hence, providing an opting-out possibility for this proportion of agents could resolve their worries, enabling them to not use this feature when they feel the need.

- Collaboration nature

  Two main strategies that DM can follow are encouraging collaboration or competition amongst the agents. However, these strategies may not fit the preferences of the agents, hence fail to increase motivation or even create unwanted stress. Therefore, knowing whether agents prefer to collaborate with each other or compete can help achieving a better design of DM.

- Relations

  There are four type of relations that can exist between constituents in a BIS environment. These relations are described as follows:

Relations between actors and a task:

With regards to DM, if there is a relation between some actors and a task, it is either a collaboration relation, meaning actors collaborate with each other to achieve the goal, e.g., a warehouse stock rearrangement, or a competition relation, which means actors compete to perform the task, e.g., sales.

Relations between two tasks:

Two tasks can have a dependency relation with each other, meaning one cannot commence without the other one providing information or resources.

Relations between a task and an actor:

Beside the perform relation, there are three relations available between a task and an actor. One is a delegation relation which represents a delegation of a task from one actor to another. Second is the ownership relation, which represents whether an actor owns a task or not. This relation is helpful mostly when there is a delegation relation. Another relation between a task and an actor is the genuine interest of performing a task by an actor. Normally, this case is represented when a task is delegated from an actor to another.

Relations between two actors:

There are two relations between actors in a BIS from the perspective of DM, supervision and promotion. Both relations try to sketch the organisational structure of the BIS, however, they have distinct usages. A supervision relation is available when an actor can supervise another actor. This allows the supervisee to have access to some work-related information that normally are not available to others in the BIS. The promotion relation tries to find the positions that actors can be promoted to. This relation can help detecting some conflicts of interest in specific cases.

Relation between agents and personas:

Agents in a BIS should be mapped to the personas created in the environment. It should be considered that based on the context, e.g., for various actors, agents may choose different personas. **Relation between agents and tasks:**

In some cases, it matters in the BIS to know which agent is delegating which task to which agent. Therefore, mapping these relations can provide designers with useful information that can aid them in a healthier design.

2.1.2 Motives

A motive consists of three parts, the reward it is providing, the information it is capturing, and the persuasive technique it is employing. Each of these parts have their own characteristics and parts which are described in the following:

Reward The reward that a motive introduces to a BIS is important from four perspectives, the policy it is following, the persuasion element it is using, the nature of the reward, and strategy it is following.

- Policy
  The policy of rewarding the motive employs could be divided into three parts. The policy can encourage competition, and/or collaboration. The competition/collaboration could be between groups or individual within a single group. It is also important to know whether the reward uses the individual performance of the agents or a collective performance of the groups.

- Element
  The elements that rewarding can use are diverse and each may need a different approach for the design to be aligned with the BIS. The element could be social recognition, encouraging agents to be better by providing a possibility of being

known for their performance. The element could be communication, facilitating the collaboration between the agents, it could be accomplishment, providing a feeling of achievement for the agents.

- Nature
  The nature of the reward is a very important characteristic and if aligned with the personality of the agents, it can help increasing the motivation and engagement. The nature of the reward could be tangible or intangible. People may find any of these types motivating based on their preferences. It is important to know the users and the rewards being introduced to an environment, then aligning the nature of the reward with the preferences of the users could prevent any incompatibility and pave the way for a more compatible DM setting for the agents in the BIS. It should be noted that a combination of both natures can be employed to satisfy agents from both preferences.

- Strategy
  The strategy of the rewarding is a very influential factor in the design of the setting of a motive. A strategy could be transparent and available to everyone in the BIS which can help in the acceptability of the results. However, this may not be the option for some BIS depending on the business plans they have. Another factor is the value of the reward and the chance of winning the reward. Despite the appeal of a high value reward may have, normally the high value of a reward has a correlation with the scarcity of the reward as well. Agents may have different preferences with regards to the value and reachability of the rewards. Some agents would only be motivated if they know that they will win a prize which is high in value and do not find smaller prizes motivating and worthy of the effort. On the other hand, some other agents may argue that certain people will always win the prize and become demotivated since they do not see any chance for winning the prize. Therefore,

they would prefer a lower value prize, but with a higher chance of winning. Another possibility is providing both high value and low value prizes and paving the ground for both types of agents to be motivated.

- Points
  Another aspect of a rewarding strategy that is important is the way points are given to the agents. Points could be given on a pre-defined manner, meaning that at the end of each task the agent will receive a certain amount of points. This may seem reasonable for many agents; however, another view may argue that a quality-oriented task should require a calculation of the points and the outcomes should be assessed for their quality before points are assigned. This can help keeping agents with quality-oriented tasks to perform at their higher potentials and do not do the jobs in a cursory manner.

- Reinforcement
  The motive can have a positive reinforcement, negative reinforcement, or a combination of both. It is very important for the analysis of the system-as-is or the system-to-be to know if there exists any negative reinforcement as it can be very detrimental and drive agents to perform unethical just to avoid the negative consequences of not meeting the desired behaviour or outcome.

Captured information DM relies on the information it captures from the environment. The agents have two concerns with regards to what DM does with their information. First one is from the visibility perspective, that is who can access the information. For some situations, agents may find it acceptable for everyone to have access to their information. Some other circumstances may arise some concerns and agents may agree for their information to be available to the relevant peers only. In some other cases, agents may opt for a more conservative measure and agree to have the

information available to their managers only. There can be imagined some situations where agents only want to have the information available to themselves as a self-monitoring mechanism.

Other than visibility of the information, agents are concerned about what is stored about them by means of DM. Since DM can facilitate sensors, actuators, software, and other digital mediums, they can be very intrusive in terms of the type of information it can capture or derive from the captured information. Therefore, agents are concerned about this information that is stored about them using DM. They are mainly concerned whether the information is personal or work related information. And whether the work information is detailed or general. Agents showed concern with regards to what can be derived and inferred from the captured information, e.g., their working habits. Another aspect is the frequency of capturing the information, that could vary from a real-time data collection to very low frequency data collection which could be at the end of every week.

Techniques Per Foggs persuasive model [4], there are seven different techniques that can be facilitated to persuade people to perform in certain manners. DM employs these seven techniques, conditioning, self-monitoring, surveillance, tunnelling, reduction, tailoring, and suggestion, which will be described in the following:

- Conditioning
  Conditioning is the process of persuading agents by means of rewards and incentives. Self-monitoring and surveillance The other two tools that Foggs persuasive model provides are self-monitoring and surveillance. The data collection and information interpretation of DM makes it feasible to provide the agents with self-monitoring or surveillance. The surveillance can be performed by means of the managers or even the peers of the agents, depending on the design of the DM.

- Tunnelling
  Tunnelling can be described as providing the path to the goal

and reducing the distractions in the way. An example of tunnelling in DM is the goal setting and breaking down the tasks into smaller ones.

- Reduction
  Reduction is the process of making the tasks easier by removing or automating some processes for the tasks. It normally dictates how tasks should be performed and agents do not have control on the process.

- Suggestion
  Suggestion is detecting the presence or lack of certain behaviours and alarming the agents with messages to prevent or persuade them to act in certain manners.

3 Formal specification

This section provides the mathematical definitions for the properties that are needed for modelling DM as a system-to-be or as a system-as-is:

3.1 Environmental Properties

Let $Ac = \{ac_1, ac_2, ac_3, \dots, ac_n\}$ be a set of *Actors*, $P = \{p_1, p_2, p_3, \dots, p_n\}$ be a set of identified *Personas*, $Ag = \{ag_1, ag_2.ag_3, \dots, ag_n\}$ and $T = \{t_1, t_2, t_3, \dots, t_n\}$ be the set of *Agents* and *Tasks* in the environment.

- **Definition 1.** Tasks
  $\forall t \in T, t =< Uniformity, Measurability, Quality-oriented|$
  $Uniformity, Measurability, Quality{-}oriented \in \{true, false\}$

- **Definition 2.** Relation between *Agent* and *Persona*
  $AgP = \{agp_1, agp_2, agp_3, \dots, agp_n\}$ is defined as a set of relations available between the agents and the personas present in the environment. Then,

  $\forall agp \in AgP, agp =< ag_i, ac_i, p_i, rel | ag_i \in Ag, ac_i \in Ac, p_i \in P, rel = Has >$

- **Definition 3.** Relation between *Agent* and *Actor*
  $AR = \{agac_1, agac_2, agac_3, \dots, agac_n\}$ is defined as a set of relations available between agents and actors in an environment. Then,
  $\forall agac \in AgAc, agac =< ag_i, ac_i, rel | ag_i \in Ag, ac_i \in Ac, rel = Plays >$

- **Definition 4.** Relation between two *Agents*
  $AgAg = \{agag_1, agag_2, agag_3, \dots, agag_n\}$ is defined as a set of relations available between two agents in the environment. Then,
  $\forall agag \in AgAg, agag = \{ag_i, ag_j, rel | ag_i, ag_j \in Ag, rel \subset \{Acquintaince, Close\}\}$

- **Definition 5.** Relations between two *Agents* and a *Task*
  $AgAgT = \{agagt_1, agagt_2, agagt_3, \dots, agagt_n\}$ is defined as a set of relations available between two agents and a task in the environment. Then,
  $\forall agagt \in AgAgT, agagt =< ag_i, ag_j, t_i | ag_i, ag_j \in Ag, t_i \in T, rel = Delegated >$

- **Definition 6.** Relation between two *Actors* and a *Task*
  $AcAcT = \{acact_1, acact_2, acact_3, \dots, acact_n\}$ is defined as a set of relations available between two actors and a task in the environment. Then,
  $\forall acact \in AcAcT, acact =< ac_i, ac_j, t_i, rel | ac_i, ac_j \in Ac, t_i \in T, rel \subset \{Competition, Collaboration\}$
  $\& rel \neq \{Competition, Collaboration\} >$

- **Definition 7.** Relation between *Persona* and *Actor*
  $PAc = \{pac_1, pac_2, pac_3, \dots, pac_n\}$ is defined as a set of available relations between actors and present personas in the environment. Then,
  $\forall pac \in PAc, pac =< p_i, ac_i, rel | p_i \in P, ac_i \in Ac, rel \subset \{Plays, Weight\} >$

- **Definition 8.** Relations between *Actors*
  $RR = \{acac_1, acac_2, acac_3, \ldots, acac_n\}$ is defined as a set of available relations between actors in the environment. Then,
  $\forall acac \in AcAc, acac =< ac_i, ac_j,$
  $rel|ac_i, ac_j \in Ac, rel \subset \{Supervision, NextRole\} >$

- **Definition 9.** Relations between *Tasks*
  $TT = \{tt_1, tt_2, tt_3, \ldots, tt_n\}$ defined as a set of relations between tasks in the environment. Then, $\forall tt \in TT, tt =< t_i, t_j, rel|t_i, t_j \in T, rel = Dependency >$

- **Definition 10.** Relations between *Tasks* and *Actors* $TAc = \{tac_1, tac_2, tac_3, \ldots, tac_n\}$ is defined as a set of available relations between the actors and the tasks. Then,
  $\forall tac \in TAc, tac =< t_i, ac_i, rel|t_i \in T, ac_i \in Ac, rel$
  $\subset \{Performs, Owns, NoInterest\} >$

3.2 Motives

- **Definition 11.** Reward
  $RW = \{rw_1, rw_2, rw_3, \ldots, rw_n\}$ is defined as a set of rewards that motives can have. Then,
  $\forall rw \in RW, rw =< Policy, Nature, Strategy, Elements >$
  where: $Policy =< type, value|$
  $type \in \{competition, collaboration, combined\} >$ **and**
  $Nature =< type|type \in \{tangible, intangible, combined\} >$
  and
  $Strategy =< transparency, value, chanceofwinning, points,$
  $reinforcement|transparency \in \{true, false\},$
  $value \in \{high, low, balance\}, chanceofwinning \in$
  $\{high, low, balanced\}, points \in \{pre-defined, calculated\},$
  $reinforcement \in \{positive, negative, combined\} >$ **and** $elements =$

  $\{e_1^n | e \subseteq \{socialrecognition, communication, accomplishment,$
  $timepressure, \ldots\}\}$

- **Definition 12.** Technique
  $Te = \{te_1, te_2, te_3, \ldots, te_n\}$ is defined as the set of motivational techniques that motives in an environment can use. Then,
  $\forall te \in Te, te =< reduction, tailoring, suggestion, conditioning, self-$
  $monitoring, surveillance, tunnelling|$
  $reduction, tailoring, suggestion, conditioning, self-monitoring,$
  $surveillance, tunnelling \in \{true, false\} >$

- **Definition 13.** Captured Information
  $CI = \{ci|_1, ci_2, ci_3, \ldots, ci_i\}$ is defined as a set of possible ways that motives can capture information. Then, $\forall ci \in CI, ci =$
  $\langle visibility, what\, is\, stored|$
  $visibility \in \{everyone, relevant, managers, self-only\}$ **and**

  $what\, is\, stored = \langle personal\, information, frequency, work\, information|$
  $personal\, information \in \{true, false\}, frequency \in \{low, medium, high\},$
  $work\, information \in \{detialedinformation, generalinformation\}\rangle\rangle$

- **Definition 14.** Motives
  $M = \{m_1^n | \forall m, m =< t, rw, tl, ci >\}$ is defined as a set of motives that can be available in the environment based on the values of all constructs of each motive and the task each motive is being added to.

4 Meta-model

We describe the meta-model for DMML in two different parts. First we provide the meta-model for the environment that the DM is going to be introduced to, then the meta-model for the DM itself.

5 Graphical representation

This section describes each concept and constituents of DMML and elaborates on how DMML can be used to model the environment a

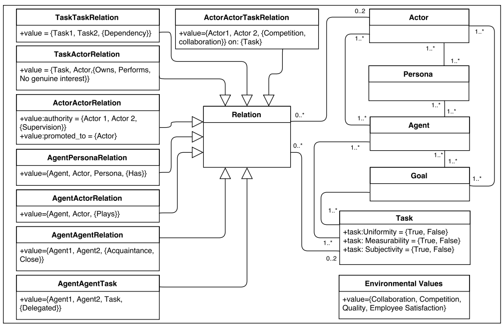

Figure 1: Meta-model for the Environment

DM design is being added to and how a motive being introduced to the BIS can be modelled and represented using DMML.

DMML builds on standard goal oriented modelling language for various reasons, therefore, most of the notations inherit their meanings from goal model. In the following we describe these notations in more details:

5.1 Modelling Parts

DMML consists of three parts. The first describes the environment at abstract level. The second one represents the environment at the instance level, and the third one models the motives in an abstract level. The combination of these three parts can help model the whole environment and analyse the impact of DM being introduced to a BIS.

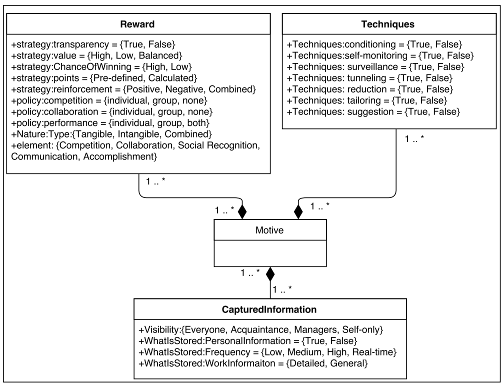

Figure 2: Meta-model for the Motives

5.1.1 Environment-abstract level

Environment can be represented through nodes and links. Nodes can be the tasks, goals, soft-goals, actors, personas, and motives in the environment. Links can be dependency, delegation, supervision, inform, promotion, ownership, No Genuine Interest, and collaboration or competition on a task/goal. These constituents are described in details in the following Table.

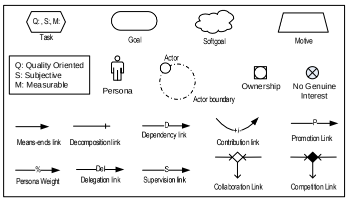

Figure 3: Legend for the Notation

Nodes	Actors	Actors can be illustrated using a circle with the name of the actor inside the circle, and can have a boundary that includes their tasks, goals, and their relations
	Tasks	Tasks can be illustrated using a hexagon with the name of the task and the values for the quality oriented, measurability, and subjectivity attributes inside the hexagon. The letters "Q", "M", and "S" can replace the full names to reduce the need for space
	Goals	Goals can be represented using an oval shape with the name of the goal inside the oval
	Soft-goals	Soft-goals can be represented as clouds with the name of the soft-goal inside the cloud
	Persona	Persona can be illustrated as the shape of a sticky man with the name of the persona under the sticky man.
	Motives	Motives can be represented with a trapezoid and the name of the motive inside the trapezoid.

Links	Actor Actor Task (AAT)	An AAT relation can be represented using a diamond with three arrows
		A white diamond represents a collaboration
		A black diamond represents a competition
		Actors are connected to the diamond via unidirectional arrows starting from the actors and ending in the diamond
		Task is connected to the diamond via unidirectional arrow starting from the diamond and ending in the task
		An AAT link overrides any direct relation between the actors and the task
	Dependency	The dependency relation is represented using a unidirectional arrow with the letter "D" in the middle of the arrow
		The direction of the arrow starts from dependers towards the dependees
	Delegation	The delegation relation is represented using a unidirectional arrow with the term "Del" in the middle of the arrow
		The direction of the arrow starts from the task/goal being delegated to the actor as the delegatee
	Informs	The inform relation is represented as an arrow from the informer node towards the information receiver
		The inform link can be bidirectional in case both nodes provide information for each other
	Promotes	The promote relation is represented as a unidirectional arrow with the letter "P" in the middle of the arrow

		The arrow starts from an actor lower in the organisational structure hierarchy and ends in another actor one level higher in the organisational structure hierarchy
	Ownership	Ownership can be represented by a badge as a box with a circle inside it attached to tasks/goals
		When the ownership badge is attached to a task/goal, it emphasises that the owner of the task/goal is the actor who has this badge in the boundary
		This badge becomes useful in case of task/goal delegations
	No Genuine Interest	The NGI can be illustrated using a badge as a circle with a cross sign inside it attached to tasks/goals
		When the NGI badge is attached to a task/goal, it emphasises that the actor who has this badge in the boundary is not interested in performing the task or achieving the goals
		This badge becomes useful in case of task/goal delegations
	Persona Weight	The weight of a persona for an actor can be represented via an arrow with the weight of the persona in percentages in the middle of the arrow
		The arrow starts from the persona and ends in the actor

5.1.2 Environment-instance level:

In the instance level, there are three relations that should be looked for. First is the relations between the actors and the actual people who perform as actors (agents). Second is the relation between

Table 2: Actor Agent Mapping Table

Actor	Agent

Table 3: Persona Agent Actor Mapping Table

Persona	Agent	Actor

Table 4: Task Delegation Mapping Table

Agent	Delegated Task/Goal	Delegated From	Genuine Interest

personas, agents, and actors. Finally, the third one is the relation regarding agents and delegation of tasks/goals to other agents. An actor may be played by various agents, and an agent may act as different actors in the environment. For ease of interpretation, we use a table, see Table. 2, to map the actors and the actual people.

The next relation is the link between personas, actors, and agents, representing available personas in the environment and the agents who assign themselves to the given personas based on each Actor separately. Since players may choose different personalities depending on the role they have in the environment, it provides more information if the persona for the players is represented with the actor they are playing. See Table. 3 as a reference.

The next link is the relations regarding the delegation of tasks in an instance level. For this purpose, we need to put together and map the name of the agent that the task is being delegated to, the task being delegated, the agent that the task is being delegated from, and, if the delegatee has a genuine interest in performing the task. Table. 4 can be used for this purpose.

5.1.3 Motives-abstract level

To model the motives being introduced to the environment, the meta-model provided should be used to facilitate the relevant information for each motive to shape its settings. We use a UML-like static structure diagram to describe motives. A general setting for each motive can be defined from the set of possible attributes that a motive can have. Each instance then can inherit the settings and have its own values for those attributes. Various instances of a class, e.g., leader-board, may be created with different values for the attributes. The instances of the motives will be used in the abstract level modelling of the environment. Since abstract level of motives can carry a lot of information, we separated their abstract modelling and only provide the instance of it in the modelling of the environment.

5.2 Motivation Requirements Analysis

Facilitating the DMML can provide BISs with viable solutions for addressing difficulties that may emerge because of introducing a DM to the system. This is possible since DMML enables an automated motivation requirements analysis and software tool support. Facilitating an automated analysis via algorithmic investigation enables identifying problems and flaws in the design of DM such as conflict of interest or sabotage. In the following, a few of these possible flaws in the design of DM with algorithms that enables their detection are provided.

5.2.1 Conflict of interest

The conflict of interest is when an agent has the possibility of hindering something in the environment to gain advantages over other agents. It can happen when there is a competition introduced by the settings of DM on a certain task/goal, and there is a dependency relation between this task/goal and another task/goal. If one agent from the competition can interfere with the dependee task, he/she

can cause disturbance in other agents performance and gain benefit from this. A healthy design of DM should be able to detect such conflict of interest and resolve this issue before introducing the DM to the BIS.

Example: In a university, the IT department consists of two teams, IT support and IT development. Employees who are a member of the IT support team are Suzy, Lucy, and Bob, also employees who are a member of the IT development team are Alice, Jack, and Bob. The IT support is responsible for maintaining and repairing the faulty computer system in the working environment. There have been several reports that the current design does not satisfy users experience. The management of the IT department tasks the development team with a new design of user interface to increase users satisfaction level. The university is seeking to provide a collaborative working environment for its employees. The IT management decides to use DM to increase motivation and engagement to work in the employees. Therefore, the decide the following plan:

The support team receives a success badge if they finish tasks within a given time which is decided and set by the project managers based on the difficulty of the tasks and the effort required. For the IT development team, the management decides to implement a leader-board of top user interface designers. When a user interface design is required, each member of the development team is asked to design an interface. The designs will be polled amongst all the employees to select the best design. The designer whom his/her design is selected receives 20 points which can be used to buy extra paid holidays for 100 points each day.

There are few problems in this scenario, first is the incompatibility of a leader-board with the environmental value of the workplace, that is collaboration. A leader-board may create an unwanted competition amongst the employees which is undesirable from the management perspective. Moreover, there is a risk of conflict of interest. The IT development need to have a working computer system to proceed and performed at a desired level. The support team is responsible for this matter, which yields a dependency link between

the user interface design task and the implementation and repair task of the support team. This may seem without any problem at first glance, however, the conflict may arise as Bob is a member of both teams. Since there is a competition in the development team, in-case there is a fault in the IT development teams computer system which requires Bob to fix the problem, Bob may decide to delay the repair for as long as he can to gain advantage over another employee/s. Algorithm 1 tries to address the detection of conflict of interest.

Algorithm 1: Conflict of Interest Detection

Input : $A : \{a \mid a\, is\, an\, actor\}$, $T : \{t \mid t\, is\, a\, task\}$,
$R : \{r \mid r\, is\, a\, relation\, \}$, $M : \{m \mid m\, is\, a\, motive\, \}$,
$AG : \{ag \mid ag\, is\, an\, agent\, \}$
Output: Possibility of "Conflict of Interest"

foreach $t \in T$ **do**
  foreach $m \in M$ **do**
    if $((t \subset m)\&\&(\text{"}competition\text{"} \subset m))$ **then**
      competitive_tasks [ ] +=t
    end
  end
end
foreach $t \in competitive\_tasks$ **do**
  if $t.Check\_for\_dependency()$==$True$ **then**
    if $((\exists(ag \in AG|t \subset ag))$ && $(\exists(t.dependee \subset ag))$
    &&
    $(\exists(ag \in AG|t \subset ag))$ && $\exists(t.dependee \not\subset ag)))$ **then**
      RETURN "Risk of Conflict of Interest"
    end
  end
end

5.2.2 Bribe for an exchange

Bribe for an exchange can happen when an agent can allow another agent to win when asking for a favour or ask another agent to let him/her win when being asked to do a favour. Bribe for an exchange can be very unpleasant from a business point of view as in the case of quality oriented tasks, this may reduce the quality since an agent may be assured about the win as a bribe. This is more likely to happen when there is a competition in place, there is a high value reward involved, and a delegation of a task which is out of the scope of the reward is happening. A healthy design of DM should be able to detect the happening likelihood of this issue and introduce preventive measures.

Example: An IT department of a university consists of two teams, the development team and the risk assessment team. Employees in the development team are Alice and Bob, and employees in the risk assessment team are Alice and Jack. The development team is tasked with designing a new user interface for the web application of the organisation and updating the payment section for the student portal which has a very firm deadline as the registration date is close and students should be able to pay their fees online. The risk assessment team is tasked with a risk analysis and preparing the report with a very firm deadline.

Bob and Alice must work on the design task, moreover, Alice must work with Jack in the risk assessment task and prepare the report. The risk assessment report should be prepared on time as it has been marked as high priority by the managers. Alice is running out of time and asks her manager to delegate her part of the updating task to Bob. The manager agrees to this if Bob volunteers to perform the task on Alices behalf.

To encourage the employees to come up with high quality designs, the managers have decided to give points to the winner design and put it on a leader-board. Those who remain in the leader-board at the end of year will receive a 500 Amazon voucher as a prize.

This scenario may seem normal at first glance, however, there is a risk hidden in the setting. Since there is a competition on a very high value prize for the design task between Alice and Bob, there is a risk of a bribe for exchange to happen. Alice needs Bob to take responsibility for the update task, otherwise, she may miss her deadline. Therefore, she may offer to let Bob win if he agrees to take the responsibility of the updating task. Also, there is the danger of Bob, asking the same from Alice. In either case, Bob will know that he will win the prize, therefore, may put minimum effort to design the user interface as he knows that he is the winner. This will result in a decrease in the quality of the user interface which is undesirable form the perspective of the management. Algorithm 2 enables the detection of bribe for an exchange.

Algorithm 2: Bribe for an Exchange Detection

Input : $A : \{a \mid a\, is\, an\, actor\}$, $T : \{t \mid t\, is\, a\, task\}$,
$R : \{r \mid r\, is\, a\, relation\}$, $M : \{m \mid m\, is\, a\, motive\}$,
$AG : \{ag \mid ag\, is\, an\, agent\}$
Output: Possibility of "Bribe for an Exchange"

foreach $r \in R$ **do**
    if "*Delegate*" $\in r$ **then**
        Agents[ ] = r.extract(ag)
    end
end
if $(\exists(m \in M \mid$ "*competition*" $\in m))$ **then**
    Tasks[]=m.extract(t)
end
foreach $t \in$ *Tasks[]* **do**
    if $(Agents \subset t.extract(ag))$ **then**
        RETURN "There is a risk of Bribe for an Exchange"
    end
end

5.2.3 Free riding

Free riding is when a group member performs less than the required share as he/she perceives that other members will do the job. Free riding can increase the tension in group activities and decrease the performance of the group. It is likely to happen when there is a group activity and personal contributions are not captured via DM. In addition, it is more likely to happen if an individual agent has no genuine interest in the goal to be fulfilled. Such as a case where an agent is delegated a task from another group which he/she will not benefit from the gained rewards.

Example: In a university, the IT development team consists of two teams, front-end development and back-end development. Employees in front-end development team are Alice, Bob, and Mary, and employees working in the back-end development team are Jack, Matt, and Suzy. The front-end team is tasked with updating the current user interface design, which has caused confusion in how the system should be used. The managers have given this task a high priority and are asking the front-end team to solve the problem and update the interface as soon as possible. To increase motivation and engagement in the employees, the managers have decided to give points to each team for their tasks. These points will be used as tokens that can be spent on extra holidays.

Bob from the front-end development team has called sick and cannot make it to work for a couple of days. To help the front-end team, the managers assign Bob from the back-end team to help in the updating tasks.

Although the settings in this scenario may seem fine, the problem arises when Bob from the back-end team is assigned to the front-end team and the updating task is delegated to him. Since the rewarding system does not acknowledge his contribution from another team and the points will be given to the front-end team which he is not a member of, and the points will not be carried to Bobs main team, he may put minimum efforts and rely on the fact that the other team members will do the task at the end. Algorithm 3 provides the

detection of free riding.

Algorithm 3: Free Riding Detection

Input : $A : \{a \mid a\, is\, an\, actor\}$, $T : \{t \mid t\, is\, a\, task\}$,
$R : \{r \mid r\, is\, a\, relation\}$, $M : \{m \mid m\, is\, a\, motive\}$,
$AG : \{ag \mid ag\, is\, an\, agent\}$
Output: Possibility of "Bribe for an Exchange"

foreach $m \in M$ **do**
end
if *m.reward_policy.performance==“group”*
&&
m.reward_policy.competition == True **then**
    Task=m.extract(t) **if**
    $(\exists(r \in R \mid$ "*delegate*" $\in r \&\& Task \in r))$ **then**
        RETURN "There is a risk for Free Riding"
    end
end

5.2.4 Sabotage

Sabotage is when an agent finds an opportunity to hinder the performance of a group to increase the chance of winning for another group. This is very unethical and businesses would not like to create an atmosphere that persuades agents to act in this manner. Sabotage is more likely to happen when there is a group competition in place for a valuable prize. However, circumstances lead the situation to a state where an agent from a competing group is delegated a task which has an impact on the agents chance of winning the prize. This is very unhealthy and should be detected and resolved prior to the design and implementation of the DM.

Example: In a university, the IT department consists of two teams, front-end development and back-end development. Employees in front-end development team are Alice, Bob, and Mary, and

employees working in the back-end development are Jack, Matt, and Suzy. The front-end team is tasked with updating the current user-interface design, which has caused confusion in how the system should be used. The managers have given this task a high priority and are asking the front-end team to solve the problem and update the interface as soon as possible.

To increase motivation and engagement in the employees, the managers have decided to give points to each team and the top performer teams will appear in a leader-board. At the end of each week, the team with the highest score will receive a token. The tokens can be used at the end of each fiscal year to give a raise to the salaries of the members of the team with the highest tokens. The points are given to the groups and not individual basis.

Bob calls sick and cannot make it to work for a few days. The managers delegate Bobs tasks to Jack from team 2.

In this situation, there is a competition on a high value reward between the front-end and back-end development teams. When Bob from the front-end team calls sick and his task is delegated to Jack, this creates a risk of allowing Jack exploit his presence in the rival group and hinder the tasks since he knows that his individual performance is not being monitored. Jack will benefit from the front-end team losing some points which can help his own team in the competition. Algorithm 4 helps the detection of sabotage.

5.2.5 Secrecy

Secrecy is when agents find a solution which can aid in achieving the business goals with a higher quality or performance. However, decide to keep it as a secret of their group since it provides them with benefits. This is likely to happen in cases where groups or agents are competing for high value prizes and the sharing of information has lower value or even no value. This will prevent all the other agents and groups from using the found solution and will prevent the organisation from higher performance or quality. A design of DM should be able to detect and prevent secrecy from happening.

Algorithm 4: Sabotage Detection

```
Input  : A : {a | a is an actor}, T : {t | t is a task},
         R : {r | r is a relation }, M : {m | m is a motive },
         AG : {ag | ag is an agent }
Output: Possibility of "Sabotage"
foreach m ∈ M do
    Actor = m.extract(a)
    if (m.reward.policy.performance == "group"  &&
    m.reward.policy.competition == true) then
        Task=m.extract(t)
        if (∃(r ∈ R|("delegate" ∈ r)&&(Task ∈ r))) then
            Agent=r.extract(delegatee)
            if (Agent ∉ Actor) then
                RETURN "There is a risk of sabotage"
            end
        end
    end
end
```


Example: In the IT department of a university, there are various teams working on UI designs, trying to create interfaces that users find convenient and appealing to use. Different factors play a role in a good design of UI such as response time, appearance, etc. The organisation is looking for the most convenient and user friendly design that the teams can come up with. The UI holds a great value for the organisation as it attracts or repels the clients while using the organisations web site.

The organisation values collaboration and sharing of information within groups and individuals. They also want to encourage teams to find the best frameworks and apply them to come up with the best UI designs. Therefore, they decide to gift shares to the members of the team that makes the most effective UIs during the fiscal year by using a leader-board.

This setting of DM my increase the risk of secrecy in the environment. The reason for this risk is the incompatibility of having a competitive element, very high value reward, and the expectation of collaboration. Teams may find frameworks or solutions that can help designing very effective and efficient designs. Nevertheless, it is in their interest to keep the solution inside the team as a secret as it can help them win more points. Algorithm 5 detects the possibility of secrecy to happen in a BIS.

5.2.6 Workplace intimidation

Several circumstances can lead to workplace intimidation and bullying. An example of workplace intimidation is when agents with higher performance group together and put pressure on agents with lower performance. The likelihood of workplace intimidation increases when the agents are compared with each other or they have access to each others performance, weaknesses, or strengths. A healthy design of DM should consider the probability of happening of work intimidation and provide preventive measures.

Example: In the IT Department of a university, the front-end development team is responsible to make sure that the UX is kept at

Algorithm 5: Secrecy Detection

```
Input  : A : {a | a is an actor}, T : {t | t is a task},
         R : {r | r is a relation }, M : {m | m is a motive },
         AG : {ag | ag is an agent }
Output: Possibility of "Secrecy"
if environment.value == "Collaboration" then
    if  (∃(m ∈ M|m.reward_strategy.element ==
     "Competition")) &&
     (m.reward_strategy.value == "High") then
        RETURN "There is a risk of secrecy
    end
end
```

a satisfactory level and update the UI when necessary to address the requirements of the customers. Collaboration of the team members is crucial to the success of the team and failure in a proper communication and collaboration may lead to a drop down in the final artefact. The UI holds a very important value for the organisation as this is the face of the university in the students' eyes. Therefore, the management wants to decrease the chance of a failure in the design of UI as much as possible.

In order to encourage collaboration, the organisation tries to reward the front-end development team as a group through badges. For communication and tracking purposes, team members have access to each others detailed work performance by the use of a progress bar. This can help them schedule the plan and make changes easier if necessary.

Although this scenario may seem with not detrimental side effect, it can be argued that providing detailed work related information to people in the same group may lead to creation of clusters of best performing employees which can put pressure on other team members, or even may pave the way for workplace bullying. The other team members may still have a satisfactory level performance

from the perspective of the organisation, however, they may not be at the same level of some top performers. Algorithm 6 helps in detecting the possibility of workplace intimidation.

Algorithm 6: Workplace Intimidation Detection

```
Input  : A : {a | a is an actor}, T : {t | t is a task},
         R : {r | r is a relation }, M : {m | m is a motive },
         AG : {ag | ag is an agent }
Output: Possibility of "Workplace Intimidation"
if (environment.value=="Collaboration") then
    foreach m ∈ M do
        if  ((m.rewarding_policy.performance =="Group") &&
         (m.captured_information_workrelated=="detailed")
         &&
        (m.captured_information_visibility == "relevant
         peers")) then
            RETURN "There is a risk of workplace
             intimidation"
        end
    end
end
```

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