

Document Version

Final published version

Citation (APA)

Kuijpers, A., Lukosch, H., & Verbraeck, A. (2019). Exploring a Mixed Method Approach: Simulation Games and Q Methodology. In A. Liapis, G. N. Yannakakis, M. Gentile, & M. Ninaus (Eds.), *Games and Learning Alliance- 8th International Conference, GALA 2019, Proceedings* (Vol. 11899, pp. 522-529). (Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics); Vol. 11899 LNCS). Springer. https://doi.org/10.1007/978-3-030-34350-7_50

Important note

To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright

In case the licence states "Dutch Copyright Act (Article 25fa)", this publication was made available Green Open Access via the TU Delft Institutional Repository pursuant to Dutch Copyright Act (Article 25fa, the Taverne amendment). This provision does not affect copyright ownership.
Unless copyright is transferred by contract or statute, it remains with the copyright holder.

Sharing and reuse

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy

Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

Green Open Access added to TU Delft Institutional Repository

'You share, we take care!' - Taverne project

<https://www.openaccess.nl/en/you-share-we-take-care>

Otherwise as indicated in the copyright section: the publisher is the copyright holder of this work and the author uses the Dutch legislation to make this work public.



Exploring a Mixed Method Approach: Simulation Games and Q Methodology

Anique Kuijpers^(✉), Heide Lukosch, and Alexander Verbraeck

Faculty of Technology, Policy and Management,
Delft University of Technology, Jaffalaan 5, 2628 BX Delft, The Netherlands
a. g. j. kuijpers@tudelft.nl

Abstract. In this paper we explore the possibilities to combine two research methods we regard as being very useful when interacting with stakeholders in complex systems. We discuss a mixed research methods approach, based on the Q methodology and a simulation game. In a game design process, translating the real or reference system into the game design is an intricate process and rather challenging due to the complexity of today's societal systems. As shown by various studies, different data techniques are proposed in order to translate reality aspects. One of the proposed data gathering techniques in combination with simulation games is Q methodology. Q methodology is a suitable method to retrieve social perspectives of stakeholders on a particular topic. Yet it is still elusive how the results of a Q methodology can be used in a game design process. In this paper, we explore the possibilities how to combine the two methods and how to translate the results of the Q analysis into a game design concept. In the context of a case within the domain of transport and logistics, we discuss how such mixed research methods approach could look like. We conclude with a future outlook on our research.

Keywords: Simulation games · Q methodology · Mixed method approach · Game mechanics

1 Introduction

Simulation gaming is an appropriate method to analyze, understand, represent and design complex systems [1–4]. Analysis and translation of reality aspects into a game environment is important since it is a starting point for the game design process [2, 5]. While this translation is important, it is also difficult because current societal systems, such as the domain of transport and logistics, are rather complex. They consist of social subsystems (e.g. individuals, organizations) and technical systems (e.g. innovations) that interact with each other [6], while having interdependent processes. Illustrating this in the transport and logistics system, it comes obvious that global and local organizations interact with each other by means of technical and social innovations. Additionally, each organization has its own needs, interest and processes. When developing an instrument to be used in such system, for example to support decision-making, or to foster communication, one has to develop a proper understanding of this reference system, including its subsystems and dynamic relationships. In complex systems,

phenomena occur that are difficult to capture and fully understand, for example situational awareness and trust. Actors in the system may have different viewpoints on such phenomena. These different viewpoints, however, provide a better understanding of the communication around a topic within a complex system that is interesting to take into account when designing a simulation game.

To create a good understanding of the processes, communication streams and phenomena that emerge in the system, simulation games can be used in conjunction with additional methods. According to [7] and [4], simulation games are an appropriate method to combine with other instruments. One of the methodologies that can be used to complement the game design process is the Q methodology [7]. A Q study allows researchers to study and explore patterns and social perspectives of stakeholders on a specific topic [8]. It is a systematic way to explore and cluster various, subjective perspectives of stakeholders on a topic. As aforementioned, a complex system consists of a multitude of actors each with their own perspectives on a topic or issue that exists in the system. In our opinion, Q methodology is a suitable tool to analyze expressions and communication of actors on a particular phenomenon in a complex system. This method provides insights into different aspects of the topic and moreover the subjectivity of opinions is analyzed systematically. This paper aims to explore the possibilities to use a Q study in the design process of simulation gaming.

Although this approach is discussed as a suitable research methodology in relation to simulation games, it did not receive a lot of attention in the field of simulation games yet. Therefore, in this paper, we explore the possibilities to combine the Q-methodology and simulation games. First, we discuss how these two methods can complement each other. Subsequently, the essential steps of a Q methodology are described in Sect. 2. Followed by a description of a case study where we want to apply Q methodology in combination with simulation games. We conclude with a future outlook.

2 Combining the Q-Methodology and Simulation Games

Simulation games are used as research instruments, training tools or instruments to raise awareness, transmit knowledge or to enable a learning process. When designing a simulation game, one of the important aspects is the translation of the reference system towards the gaming system [2]. A multitude of game design approaches propose how to translate the reality aspect into a simulation game, for example, [2] or [9]. Both of these approaches discuss the importance of translating the reality aspect into a simulation game. By including subject-matter experts [2] or the target group [9] with the design process, information is shared that help to clarify and identify important aspects of a complex system. The Q methodology can be used to support this game design step.

Based on related game design approaches, literature studies, interviews and workshops with experts and practitioners are suitable tools to understand the system in-depth and moreover to clarify the problem [10]. The data retrieved from the above-mentioned tools serve as a basis to map the system in a systematic way [11]. Besides these tools, in our opinion other research methodologies, such as Q methodology, are suitable in conjunction with simulation games to gather data, for example different

viewpoints of stakeholders. During the design process, it is challenging to include all viewpoints of the different actors in the system on a particular topic. Yet, for the analysis of the system it is interesting to collect similar and dissimilar viewpoints to create a thorough analysis of the complex system.

Combining simulation games with other research methodologies is discussed in a few papers. [7] showed that games create a suitable environment for a mixed method research approach. As shown in this paper, a Q study is considered as an appropriate methodology to collect data. With a Q study, data is gathered that gives insights into the opinions or motivations of stakeholders on a certain topic [12]. Another study that elaborates on the combination of different research tools is the study by [4]. This study discusses different types of simulation games by game design and evaluation. From the various case studies it is learned that transferring reality aspects during the game design process is an intricate process and interviews with experts and workshops help to support this translation.

In our opinion, one methodology that is useful in relation to game design is the Q methodology. A Q study consists of both qualitative and quantitative elements [8, 13, 14]. This methodology is used to analyze social perspectives of a variety of stakeholders [14] as well as to extract patterns of these perspectives [15].

2.1 Q Methodology

A Q study is suitable to study a social phenomenon which is subjected to different understandings and which is debated quite a lot [8]. A Q study will provide insights and feedback on a topic as well as knowledge of the reference system. According to [8, 12, 14], conducting a Q study consists of 5 subsequent steps. The first step of a Q study is the demarcation of concourse. In this first step, expressions and information flows on a topic are identified that reflect the diversity of perspectives from actors in a system [12, 14]. Based on the concourse, statements are defined that reflect the diversity of the perspective. This second research step is called the selection of statements. After the selection of the statements, the respondents are selected who will perform the Q sort. These respondents are selected based on their different perspectives on a topic [14]. The fourth step is the Q sort. In this step the respondent are asked to rank the statements according to a research question. Respondents sort the statements on a grid which is shaped as a normal distribution. Grounded on the different Q sorts by respondents, a data analysis is conducted as the fifth research step. The final step is the analysis and interpretation of the different Q sorts by means of a quantitative statistical analysis that provides to a set of factors [13, 14]. These set of factors give an overview of the shared perspectives of actors on a topic. A Q study is a systematic analysis to study a topic in a complex system. By analyzing and retrieving feedback from experts and practitioners a better understanding of the real system is created and moreover game designers are able to transfer the reality aspects into a game environment [3, 4]. In doing so, the Q methodology helps to carry out this design step in a structured way.

3 Case Study: A Game of Trust

Combining the Q methodology and simulation games did not receive a great deal of attention yet. How to combine these two methodologies is explored in the Trans-SONIC project. Within the Trans-SONIC project, the impact of trust on collaboration in light of the innovation process is studied by means of simulation games. The context of the study is the transport and logistics system, and in more detail the port-hinterland system. This system can be characterized as a complex system [6], where actors have interdependent processes and interact with each other by means of novel technologies in order to transport goods from A to B. With the introduction of novel technologies, procedures and processes of actors may change. Additionally, actors need to decide if they want to compete or collaborate with competitors. Trust in this case is key as it enhances collaboration [16]. Consider, for instance, the implementation of truck platooning in the transport and logistics system. Truck platooning is a concept where a number of trucks, from different truck companies, drive together with a fixed vehicle distance by means of communication technologies. This innovation provides advantages for truck companies, for example fuel reduction. Yet, it also causes some challenges. In order to establish a platoon, truck companies need to share information, such as departure times or truck driver schedules, with other truck companies. In order to exploit the advantages of truck platooning, collaboration and moreover trust is vital.

In the Trans-SONIC project, we develop a trust game according to the Triadic Game Design (TGD) Philosophy proposed by [2]. According to the TGD philosophy, a game design approach should be balanced along three aspects, i.e. reality (i.e. translation of the reference system), meaning (i.e. the purpose/learning goal of the game) and play (i.e. game elements/mechanics). We develop a round-based game where players experience the influence of a low trusted environment or a high trusted environment. In the game we are interested how trust influences initial collaborative relationships in the port-hinterland system, thus in an inter-organizational environment.

The port-hinterland system is rather complex and to understand the system in-depth, a system analysis is conducted to gain insight into the actors, their relations and interests. Subsequently, we visualized the information and communication stream of the actors by means of a business modelling approach. For example, the actors and their processes are visualized by the use of a swimming lanes model. With the system analysis we are able to represent the main roles in the game as well as the communication streams.

As aforementioned, the main concept in the game is trust. In order to translate this social phenomenon in a game, first a literature review is conducted. The results of this literature review show that the concept of trust is multidimensional. It evolves over time and emerges in different stages [17], for instance on a personal level as well as on an institutional level. Deriving from the literature review, trust is defined as an expectancy that emerges in a technological environment or a social environment [18]. Since the purpose of the game is to study the influence of inter-organizational trust (i.e. low and high trust) on initial collaborative relationships, our concept of trust is based

on the definition proposed by [19]. According to this study, trust is an organizations expectancy that another actor will fulfil its obligations, behaves in a predictable manner and is not opportunistically [19]. The role descriptions are based on the trust characteristics of this definition. For instance, one player in the game will behave opportunistically compared to another player who will behave predictable.

We are aware that trust embedded in a system and is influenced by various factors, for example power and risk. Grounded on literature from a broad range of disciplines (e.g. sociology, management) we could derive that information is a construct that influences the process of trusting another actor [20]. In other words, the choice whether or not to collaborate is moderated by the received information and this varies per stakeholder.

3.1 Q Methodology: Input for Game Mechanics

To translate the relation between information, trust and collaboration we first need to create a better understanding what the role of information is in the transport and logistics system. We do this by means of a Q study. For example, the construct information consists of different types such as fixed information (e.g. container code) or future events (e.g. turnaround times terminal) [21]. A Q study allows researchers to identify underlying patterns of the stakeholders on a social perspective [21], in our case information in relation to trust. Our hypothesis is that the Q methodology allows us to ensure that critical elements of the relation information and trust are translated to the game environment.

As explained in Sect. 2, conducting a Q study consists of 5 subsequent steps [8]. To set up the concourse, we will analyze journal articles and grey literature (expert reports and news articles) in depth. This will provide us with a better insight of the relation between information and trust, as well as the communication about this topic in the port hinterland system. Following from the concourse, Q statements will be defined that cover all the relevant aspects of the topic. For example, information in relation to trusted third parties or what type of information (e.g. feedback ratings, operational information) is trusted by the stakeholders. After formulating the Q statements we select port-hinterland stakeholders who have different viewpoints. The stakeholders then need to sort the statements on a grid-shaped normal distribution from strongly disagree to agree which are afterwards analyzed by a factor analysis [13]. Resulting from the factor analysis is a set of shared perspectives from a multitude of port-hinterland stakeholders on the topic information in relation to trust.

Our hypothesis is that the outcomes of a Q study will reveal the most important elements of the topic information in relation to trust, since it will provide us with the viewpoints of the port-hinterland stakeholders. Based on this data, game mechanics will be designed (Fig. 1).

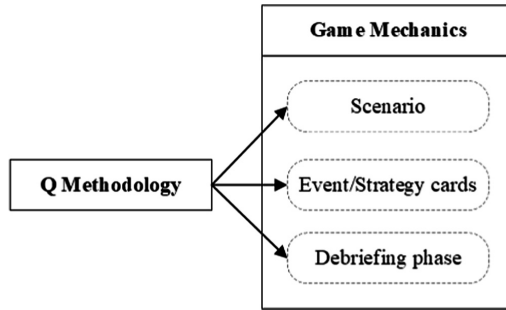


Fig. 1. Q methodology translated to game mechanics

Since the game is a round based game, one of the social perspective deriving from the Q study can serve as a scenario in one of the rounds. The output of a Q study is the shared perspectives, positive or negative, of different stakeholders on a topic. For example, possible shared perspectives of stakeholders in the transport and logistics system could be: sharing of different types of information should be regulated or the role of trust and security in relation to information is necessary. A Q study reveals in more detail the concerns and issues of stakeholders. To illustrate, take for example the shared perspective of trust and security. Stakeholders may be concerned that trusting others may be difficult and they have a positive attitude towards implementing regulations in order to increase their trust level. Grounded on this shared perspective, scenarios could be designed that provides a linkage towards reality and used to influence the game play of players. For instance, a scenario can be introduced where new rules and regulations are mentioned that affect the trust level of players. Another alternative is to use the different perspectives as input for the strategy cards where players are able to influence the environment (e.g. low trusted environment or high trusted environment). Strategy cards are a suitable game mechanic to differentiate between a high trusted environment and a low trusted environment. For example, certain information can be left out during specific game rounds. When playing one of the strategy cards certain information what is important in relation to trust is not shared by a player. Additionally, while conducting a Q study, more information and insights will be retrieved from the stakeholders. After sorting the statements, it is possible to ask more in-depth questions relating to the Q sorting. This information can also be used in a debriefing phase, where the role of information in relation to trust will be made explicit.

4 Conclusion and Future Outlook

In this paper, we explored Q methodology in conjunction with simulation games. In the literature, Q methodology is discussed as one of the possibilities to gather data. While a couple of studies discussed the opportunities of combining different research methodologies, the combination of the Q methodology and simulation games did not receive a great deal of attention. In our opinion, a Q study is beneficial for the game

design, i.e. serves as a basis for game mechanics, and moreover, insights are created on the communication about a certain topic in a system. We envision that a Q study will allow us to retrieve data on the role of information in relation to trust. By gathering data on this topic, we are able to design specific game mechanics that influence the trust level of the players. It will also enable us to create an overview of the opinions of a variety of stakeholders that provides us a better insight into the system itself. Subsequently, using this information in a de-briefing phase allow us to expand the learning process of the players as well.

In future work, we will develop the simulation game further as well as the Q study. Q statements will be defined and a pre-selection of the stakeholder will be asked to sort these statements according to a scale from strongly disagree to agree. Subsequently, the results will be analyzed which provides us perspective that can serve as input for the game design. In parallel the game of trust will be further developed. Game mechanics are designed will be designed that partially comply with the results retrieved from the Q study. Additionally, experiments will be designed to study the role of trust on collaboration in the port-hinterland system.

The overall aim of the Trans-SONIC approach is to create a better understanding of the role of trust in a socio-technical system when novel technologies are introduced.

References

1. Duke, R.D.: *Gaming: The Future's Language*, 2nd edn. Sage Publications, Beverly Hills (1974)
2. Harteveld, C.: *Triadic Game Design: Balancing Reality, Meaning and Play*, 1st edn. Springer, London (2011). <https://doi.org/10.1007/978-1-84996-157-8>
3. Kriz, W.C.: Creating effective learning environments and learning organizations through gaming simulation design. *Simul. Gaming* **34**(4), 495–511 (2003)
4. Lukosch, H.K., Bekebrede, G., Kurapti, S., Lukosch, S.G.: A scientific foundation of simulation games for the analysis and design of complex systems. *Simul. Gaming* **49**(3), 279–314 (2018)
5. Peters, V., Vissers, G., Heijne, G.: The validity of games. *Simul. Gaming* **29**(2), 20–30 (1998)
6. De Bruijn, H., Herder, P.M.: System and actors perspectives on sociotechnical systems. *IEEE Trans. Syst. Man Cybern. Part A: Syst. Hum.* **39**(5), 981–992 (2009)
7. Mayer, I.S.: The research and evaluation of serious games: toward a comprehensive methodology. *Br. J. Educ. Technol.* **45**(3), 502–527 (2014)
8. Cuppen, E., Bosch-Rekveltdt, M.G.C., Pikaar, E., Mehos, D.C.: Stakeholder engagement in large-scale energy infrastructure projects: revealing perspectives using Q methodology. *Int. J. Project Manage.* **34**(7), 1347–1359 (2016)
9. Duke, R.D.: The game design process. In: Greenblat, C.S., Duke, R.D. (eds.) *Gaming and Simulation: Rationale Design and Applications*, pp. 99–168. Wiley, New York (1981)
10. Geurts, J.L.A., Duke, R.D., Vermeulen, P.A.M.: Policy gaming for strategy and change. *Long Range Plan.* **40**(6), 535–558 (2007)
11. Peters, V., Van de Westelaken, M.: *Spelsimulaties – een Beknopte Inleiding in het Ontwerpproces (Simulation Games – A Brief Introduction tot he Design Process)*, Nijmegen, The Netherlands (2011)

12. Webler, T., Danielson, S., Tuler, S.: Using Q method to reveal social perspectives in environmental research, Greenfield, MA (2009)
13. Brown, S.R.: Q methodology and qualitative research. *Qual. Health Res.* **6**(4), 561–567 (1996)
14. Ligtvoet, A., et al.: New future perspectives through constructive conflict: exploring the future of gas in the Netherlands. *Futures* **78–79**, 19–33 (2016)
15. Barry, J., Proops, J.: Seeking sustainability discourses with Q methodology. *Ecol. Econ.* **28** (3), 337–345 (1999)
16. Nooteboom, B.: Collaboration, trust and the structure of relationships. In: Nooteboom, B., Stam, E. (eds.) *Micro-Foundations for Innovation Policy*, pp. 199–218. Amsterdam University Press, Amsterdam (2008)
17. Lewis, J.D., Weigert, A.: Trust as a social reality. *Soc. Forces* **63**(4), 967–985 (1985)
18. Mcknight, D.H., Carter, M., Thatcher, J.B., Clay, P.F.: Trust in a specific technology: An investigation of its components and measures. *ACM Trans. Manage. Inform. Syst.* **2**(2), 1–25 (2011)
19. Zaheer, A., McEvily, B., Perrone, V.: Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. *Organ. Sci.* **9**(2), 141–159 (1998)
20. Lewicki, R.J., Bunker, B.B.: *Trust in Relationships: A Model of Development and Decline*, 1st edn. Jossey-Bass, San Francisco (1995)
21. Wiegmans, B., Menger, I., Behdani, B., van Arem, B.: Communication between deep sea container terminals and hinterland stakeholders: information needs and the relevance of information exchange. *Marit. Econ. Logist.* **20**, 531–548 (2017)