

Climate Adaptation as an Economic Challenge: Finding Business Strategies by Game-based Learning

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Abstract: Climate adaptation and learning support organizations in dealing with the current and projected consequences of climate change by recognizing challenges as opportunities, ensuring business continuity and increasing their economic efficiency. Here it applies that those actors who deal with their existing framework conditions, opportunities and risks at an early stage, and also have structures or capacities for strategic learning processes, increase their climate resilience and reduce their vulnerability to negative impacts. A cumulative doctoral thesis analyze to what extent companies already have climate-related structures conducive to learning, to what extent they take responsibility in terms of the learning object (climate change), and which elements prove to be limiting here. The results illustrate that intangible resources such as a sense of responsibility, executives positive attitude and common values have a significant influence on the way companies deal with climate change. Based on these findings, a serious game will be developed and its didactic effectiveness reflected critically to raise the climate-related awareness of decision-makers and to enable them to derive their own adaptation measures.

Keywords: Climate Adaptation, Organizational Learning, Game-based learning, Economic Efficiency, Serious Games, Change Management

1. Introduction

Increasing extreme weather events, political regulations, concurrent stakeholder interests and supplier assessments are just a few of the numerous impacts caused by the global climate change companies must deal with. Climate adaptation refers to the ability and volition to cope with external changes in a constructive manner, to anticipate future developments, and to continuously adapt internal processes to these changes (IPCC 2013). Moreover, the Intergovernmental Panel on Climate Change (IPCC) defines climate adaptation as an intervention to avoid economic damages while increasing economic effectiveness (IPCC 2013). Anticipatory and reactive adaptation measures, as well as associated changes in mind-sets, protect organizations from the actual and projected impacts of climate change. Profound climate adaptation characterizes a permanent process that takes place in a systemic way, which means involving the organization and its internal and external environment. Organizational adaptation, in general terms, encompasses the ability and volition to deal constructively with external changes, to anticipate future developments, and to continuously align structures and processes. Studies on climate adaptation frequently focus on the management level, as it is crucial for the resources and its implementation (Mahammadzadeh et al. 2013; Linnenluecke et al. 2013, Meinel/Höferl 2017; Meinel/Schüle 2018; Daddi et al. 2018). Much of the referred research focuses on identifying how organizations adapt to climate change and what structures can be conducive to learning (Bianchi et al. 2021; Nicoletti et al. 2019; Kanyama et al. 2018). Generally, climate adaptation and organizational learning is essential to serve organizations continued existence, development and competitiveness in the face of major transformations and expected external changes (Nicolletti et al. 2019; Feld/Seitter 2018; Cömlek et al. 2020).

To raise awareness among decision-makers, and to enable them to develop adaptation measures, it requires an innovative approach for knowledge transfer. Serious games represent an innovative approach to knowledge transfer and teaching (Susi et al. 2007) and support to foster cognitive, social and emotional skills (Greipl et al. 2020). Frederic Vester's environmental game 'Ecopolicy', published in 1978, was one of the first examples of an innovative didactic approach in the area of climate change. Here, economic and political actors develop an understanding of the simulated consequences and derive their own strategies (Vester 2021; Nguyen/Bosch 2014). Especially in the case of educational games, the entire context in which the game is intended must be considered to ensure didactic effectiveness (Subhash/Cudney 2018). Thus, the abilities and preconditions of the target group, as well as general conditions such as time, resources, volition, etc. must be considered. Gerber et al. (2021) analysed in their systematic literature review climate related game-based learning. Here the majority of games include, besides a specific goal and competitive character, also the element of collaboration among the players, who usually take on different roles. Finally, the required space for collaboration and reflective thinking is also emphasized in the work of Flood et al. (2018). Generally, the duality of formal knowledge transfer and experienceability of extreme events and strategies generates active learning and participation. In comparison to

classical teaching methods, the approach promises an enhanced ability to apply knowledge in practice (Hamari et al. 2016; Sousa/Rocha 2019).

Since there is still a lack of research regarding the interrelated learning processes among climate adaptation, this contribution is about a doctoral thesis which analyses to what extent climate adaptation is framed within an organizational learning (OL) process.

2. Methodology and initial findings of expert interviews and questionnaire

The research described above is linked to the development of two educational modules, see Figure 1. First, a regional study is conducted to analyze how companies in an industrialized Bavarian region already adapt to climate change, in how far they have climate-related structures conducive to learning and to what extent they take responsibility in terms of the learning object (climate change). Second, based on the results of the regional study, a serious game will be developed and evaluated. Here, different roles in a company react on simulated external conditions and initiate own adaptation strategies to experience its effects for their affiliated company. The target is to enable the players to derive individual adaptation strategies.

Frame text	<p>Cumulative doctoral thesis: Climate adaptation as organizational learning. Analysis of elements that promote and inhibit learning examined at companies and handicraft companies</p>		
Subproject	<p>Paper 1: A Grounded Theory Study on Manufacturing Companies in a Bavarian Region.</p>	<p>Paper 2: Finding Business Strategies by game-based learning – Climate Adaptation as a Challenge</p>	<p>Paper 3: Acceptance and effectiveness of educational modules for climate mitigation and adaptation</p>
Purpose (Target group and scientific discourse)	<ul style="list-style-type: none"> • Knowledge of measures practiced and their effectiveness • Identification of elements that promote and inhibit learning • Discussion of factors influencing organizational learning related to climate change 	<ul style="list-style-type: none"> • Discuss and transfer measures in the collective • Testing possible combinations, understanding the effects • Analyzing the design of game-based learning approaches 	<ul style="list-style-type: none"> • Evaluation of didactic effectiveness and perceived knowledge acquisition • Influencing factors on effectiveness and acceptance of educational modules on the example of a serious game
Educational modul	Regional study	Serious game	Evaluation
Methods	<ul style="list-style-type: none"> • Semi-standardized questionnaire (N = 6.030; n = 288) • Expert interviews (n=2) • Expert interviews (n=11) 	<ul style="list-style-type: none"> • Group discussion (n = 15) • Collaborative development of a serious game 	<ul style="list-style-type: none"> • Formative evaluation of the serious game, standardized questionnaires (n = x) • Expert interviews (n = 10)
Grounded Theory Methodology			

Figure 1: Conceptual design of the cumulative doctoral thesis with its three subprojects, own figure

To motivate and enable actors from companies to develop climate adaptation measures and to integrate these measures into the business strategies, it requires a target group oriented educational approach, which is addressed by the underlying research project. The PhD, started in June 2020, additionally analyses the inhibiting and enabling elements of a strategic learning process by carrying out several qualitative and quantitative studies (expert interviews, group discussion and semi-standardized questionnaires).

The conducted qualitative study of 13 expert interviews with manufacturing companies (Fischer et al. 2022) is based on the assumption that the issues of global climate change and climate adaptation are often still complex and abstract for companies outside the primary sector (e.g. example, agricultural sector). Applying Grounded Theory, we identified the core categories ‘Economic efficiency’, ‘Dynamic organizational environment’ and ‘Change management’, which interlink all interview findings. Summarizing the results, any form of climate adaptation is subject to the dogma of economic efficiency or the drive to preserve the organization. In this context, there are mostly smaller and larger barriers organizations have to face, e.g. amortization time, requirements from customers or regulatory aspects, which are to be considered before any implementation. At the same time,

appropriate knowledge is required to restructure processes, calculate measures and develop a suitable level of action by management. Further promoters are the employees who carry out the tasks themselves, and who pass on their practical experience and knowledge to decision-makers and report optimizations. It is confirmed that a general change in attitude is taking place in many companies. There is a consensus that a business as usual approach is not sustainable and not acceptable anymore.

In a subsequent study a total of 288 valid questionnaires were analysed, of which 52 were manufacturing companies, 80 non-manufacturing companies and 155 handicraft companies. The results indicate that the indirect impacts of climate change currently predominate. While these impacts involve a variety of fast-changing legal requirements, they also concern supply chain and raw material resources within supply chains. There is a rising awareness among the companies surveyed that suppliers make their manufacturing and sourcing processes more transparent, e.g., through supplier assessments. Generally, the entire sample already deals with climate change and especially intangible factors such as a sense of responsibility, leadership's positive attitude and common values have a significant influence on the way companies deal with climate change. One limiting factor here is that it cannot be clearly distinguished whether the structures conducive to learning, such as a positive error culture, innovation openness and an external network, are merely attributable to the issue of climate adaptation or are part of the fundamental 'organizational set-up'.

3. Implications for the game development

To find an adequate way of dealing with climate change as economic organizations, executives are initially required to develop a holistic approach with comprehensive measures for climate mitigation and adaptation, and to test them for their effectiveness and integrate them holistically. The preceding analyses already provided an actual overview of the companies' perception of climate change and how they are affected by it. Since no basic terminological understanding was assumed, there was no differentiation between climate mitigation and climate adaptation measures. Accordingly, the planned business game should focus on climate adaptation in manufacturing companies, since these companies have a high consumption of energy and resources (BMUV 2022). In cooperation with the target group, executives from manufacturing companies, the serious game 'MainKassandra' is developed, see Figure 2. Its content and didactic design follows the findings of the group interview with 6-7 executives, which is still to be conducted. Using this constructivist approach in game development (Bado 2022), the experiences and educational needs of the target group will be integrated. Currently, the narrative-based serious game is in its development phase, where content, materials and learning objectives are defined. The game is designed to provide low-threshold learning access and to be carried out easily within the company independently with the assistance of a moderator. Thus, it also contains elements of pen and paper games that make use of the intuition and improvisation of players to promote the level of creativity in interaction and also address emotional aspects.

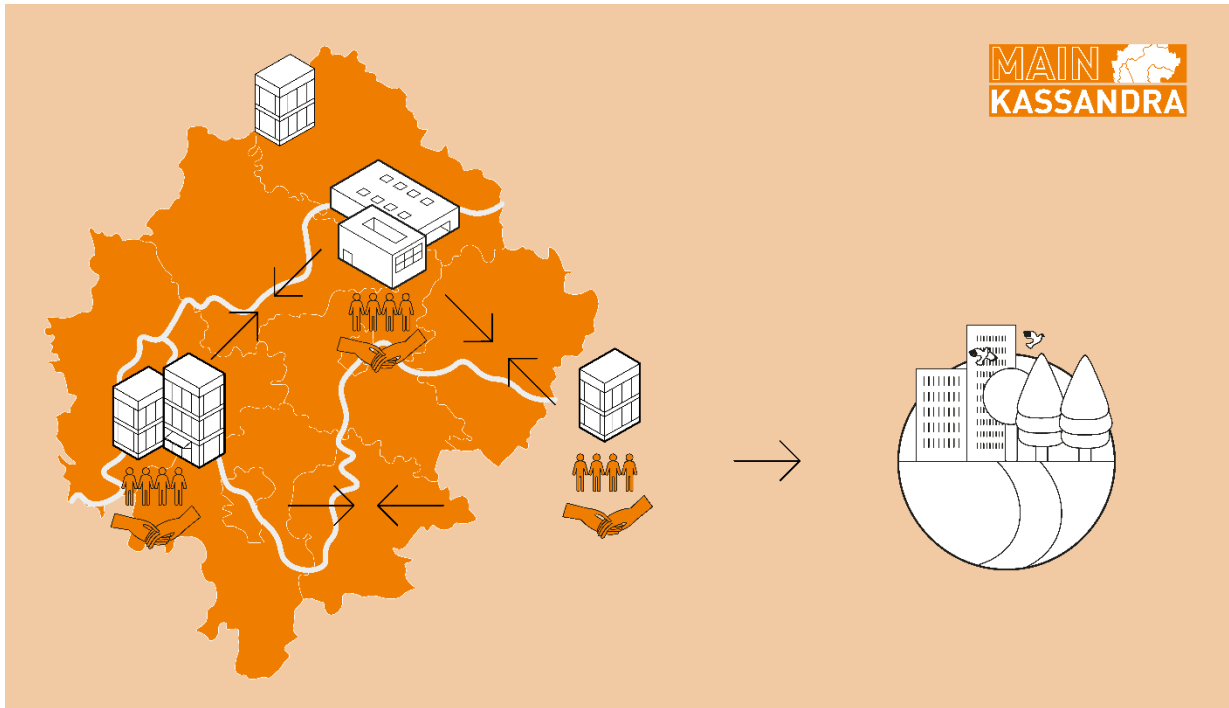


Figure 2: First game concept for 'MainKassandra', where players work collaboratively and competitively in a company in a region affected by climate change and have to make decisions and react to unexpected occurrences, own illustration

Conceptually, 'MainKassandra' is about game players developing a sustainable corporate strategy based on assigned functions, competencies and companies over several rounds and identifying their own affectedness, opportunities and risks with regard to climate change, see Figure 3. The game is played in teams facing each other in a competitive game situation, so that the different decision-making paths of the teams and their evaluation are analyzed in iterative lessons-learned phases. There are different organizational pre-conditions within the game that affect the decision-making regarding climate mitigation and adaptation strategies. Climatic events (e.g. heavy rainfall, floods) and developments in further dimensions (e.g. legal regulations, local conditions, warming, acceptability) and increasing knowledge influence subsequent decisions and strategy development. Assessment indicators, e.g. corporate image, profitability, are used to represent the effects of the decisions. 'MainKassandra' is about making decisions and acting according to the assigned functions in the team in such a way that the fictitious company proves resilient to the specific event and future climate risk issues in order to avoid economic damage.

Regarding the game development, the empirically collected climate-relevant measures are to be cataloged in order to serve as a decision-making guideline or inspiration for the players of the game. One challenge in general is to develop a low-threshold game that the companies can carry out independently during workshops with their executives, with no required training for the moderator and with no risk of having the target group feel bored or deterred, for example, by complex game logics. Consequently, a low use of resources is required, along an analog and digital implementation using game materials printed out or used digitally and complemented by digital pinboards, e.g., Padlet. To ensure effective learning, it is important to activate the players, to exchange ideas and to foster both their enthusiasm and motivation. Especially the question of resources and the question of the game logic or the score schemes regarding measures are currently in the focus of attention.

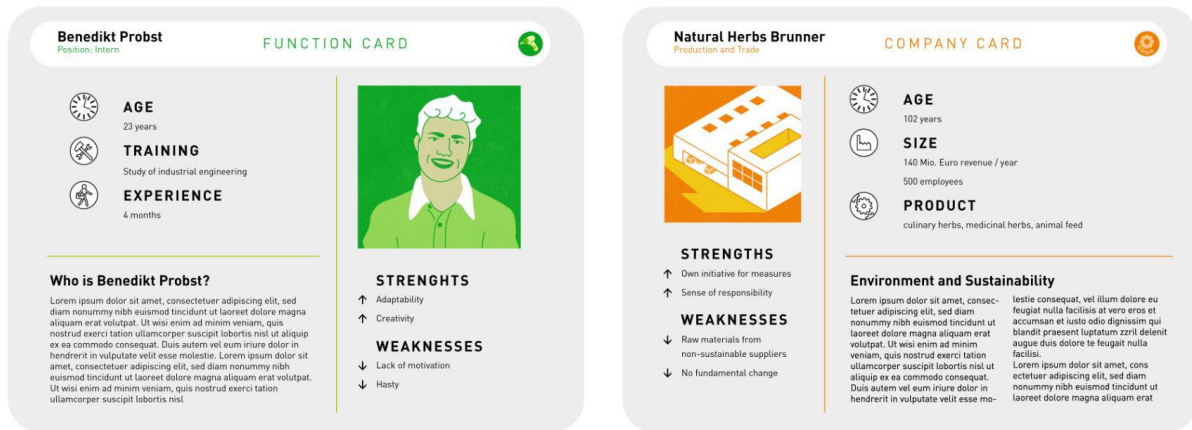


Figure 3: Design of game cards on fictitious functions and their competencies or character traits and the company cards as counterparts, own illustration.

As illustrated by economic conditions in particular and the certain unpredictability of climatic trends and extreme weather events, addressing climate change will be mandatory for all actors in economic and ecological systems in future. It is also important to note that actors who address their preconditions, opportunities and risks early and who have structures and capacities that facilitate their strategic learning processes will increase their climate resilience as well as reduce their vulnerability to uncertainties.

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