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Analysis of environmental transitions for tool development

J. Lennartz[a], M.E. Toxopeus[a,*], J.van der Meulen[b]

[a]*University of Twente, Faculty of Engineering Technology, P.O. Box 217, 7500 AE, Enschede, The Netherlands*
[b]*TNO, Princetonlaan 6, Utrecht 3584 CB, The Netherlands*

* Corresponding author. Tel.: +31-53-489-4516 . *E-mail address:* m.e.toxopeus@utwente.nl

Abstract

In the pursuit of a sustainable economy, several transitions are initiated which affect the way of doing business. The most prominent transitions, the energy transition and the transition towards a circular economy, are exemplary for the way companies are impacted. By the analysis of the differences and similarities between the two transitions, the challenges for companies are identified. The value chain needs to implement the demanded adaptations to be competitive. Therefore, the environmental performance and capacity to make the required adaptation of all value chain partners are of relevance for business continuation. A future tool should support companies in the assessment of the value chain partners to be adaptive. The paper describes the design brief for the development of the tool that should incentivize companies to focus on and provide guidance for a multi-capital approach for value creation and to transition to a sustainable value chain.

Keywords: Transition theory; Circular economy; Energy transition; Value chain

1. Introduction

There is a global consensus regarding the environmental burden caused by human activity [1]. To mitigate or prevent environmental disasters, pollution and resource dependency, the environmental impact of human activity needs to be reduced. A society-wide transition to a sustainable economy is initiated, the transition to “an economy that is resilient and provides a good quality of life for everyone” [2]. It includes striving for a social, environmental and financial optimum for the long term. This research focuses on the path to an environmentally sustainable economy.

Several sub-transitions are initiated to tackle each specific undesired effect of the current economy. The most prominent transitions are the energy transition and the transition towards a circular economy (CE). The energy transition is the shift from a fossil-based energy system to renewable energy sources [3]. The transition towards a CE is the shift from a linear economy, which is based on the concept of ‘take-make-dispose’, to a circular economy, which keeps the value of the resources on a high level [4]. The differences and similarities between these transitions have been identified, section 4, using the transition theory as explained in section 3.

Better environmental performance of products and services over the complete life cycle is essential to reduce the impact of human activity. For companies, environmental performance is becoming increasingly important from both a social and financial point of view. The growing customer demand for social responsibility and legislation to phase out products and services with undesirable environmental impacts, forces companies to join the transition. Also, the business models are affected to adhere to the initiated transitions. Section 4, describes the different challenges companies face due to both transitions.

To support companies in the environmental transitions different tools can be used. These available tools and future context are analysed and showed a new objective for tool development. The new objective as part of the design brief for tool development is described in section 5. Finally, the conclusion, section 6, and future research are described.

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2. Problem definition

The two analysed transitions in this research, the energy transition and the transition towards a CE, require adaptation of companies to a more sustainable future. The main problem addressed in this paper is how to stimulate and support companies to initiate contributing to these environmental transitions. Furthermore, it's unclear what is required to support companies in this phase of their transition process.

3. Transition theory

To gain insights into the differences and similarities of the transitions and the, expected, impact on companies, the transition theory is used. This theory presents the general course and the role of different levels within a transition by different heuristics. The theory is based on the analysis of historic transitions, such as the transition from cesspools to sewer systems or from horse-drawn carriages to automobiles [5]. The theory is approached from a socio-technical perspective since that is inherent to the context in which companies operate in the transitions at stake. They face both a societal and technological problem. The heuristics in line with this perspective are used to describe the two transitions.

3.1 Multilevel perspective

The multilevel perspective heuristic describes the relation and interaction of different levels of the transitions [6, 7]. Three different levels are identified, landscape-, regime- and niche-level, see figure 1. The regime is the current network of actors with its rules which arise from the mainstream beliefs. This is dynamically stable since they are open for changes as long as it fits and optimizes the regime. The landscape-level represents the overall structural tendencies (e.g. political ideologies, societal problems, economic trends, ecologic challenges, etc.) and other almost non-changeable material context factors (e.g. stations, cities, roads, etc.). The niches are actors that shape the opportunities for radical change. The differentiating aspect of niches in a socio-technical regime can occur on market level, technology level or both. Niches are not part of the regime since they do not add enough value, lack maturity or do not fit the regime rules. They are the potential replacements for specific aspects in the current regime or even the complete regime.

The interaction between the landscape, regime and niche levels is what eventually can cause a transition [6, 7] of the old to a new regime. This occurs when the current regime is under pressure from the landscape, for example as a result of changing political tendencies. Tensions within the regime start to rise and windows of opportunities open up for niches to interfere in the regime. Regime actors start to look at or create space for niches that comply with the new beliefs. The uptake of these niches makes it eventually possible for the regime to transform into an accepted and optimized new regime. They can fulfil the window of opportunity that is a result of the landscape pressure.

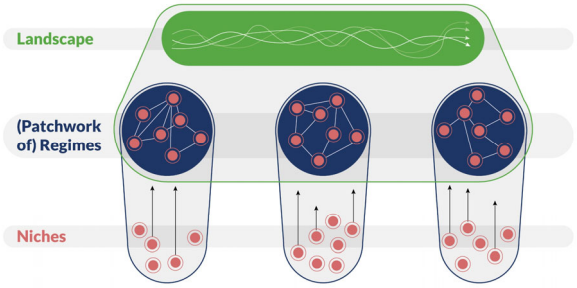

Fig. 1. Multilevel perspective heuristic [6]

3.2 X-curve

The process of changes is described by the phases heuristic. The x-curve, figure 2, presents the breakdown of the old and emergence of the potential new regime. The new regime arises from the niches, it starts slowly by experimentation, accelerates, emerges, institutionalizes and stabilizes. The support for the old regime of the sociotechnical system destabilizes to eventually break down and phase out. The different phases for the different paths within transitions are defined and the model highlights the nonlinearity of the process. It develops in a shock-wise manner due to the repositioning of actors after disruptive changes, e.g. introduction of innovation or new legislation [6].

As the curve implies, the transition can both be initiated top-down and bottom-up [6]. Initiating change top-down is focused on the demolition of the regime. Legislative measures can increase the velocity of the transition. Restructure and destruction measures can make sure to phase out the old regimes [8]. It also affects the emergence of niches, it creates a demand for a new regime. The bottom-up process is all about the development of niches to fulfil the demand for the new regime. In the context of a sociotechnical system, niches are highly related to the development of innovative solutions. Compiling innovation systems [7] and creating innovation policies [9] can fuel the transition bottom-up. Innovation policy is a type of construction measure that supports niche development [8]. For the environmental sustainability challenges, this goes beyond the economic growth as was common in the traditional innovation system and policy. The innovation needs to contribute to the particular mission of the transition and consider the societal implications [9]. The role of the top-down transformation is just as important as niche development to complete the transition from the old regime to a new regime.

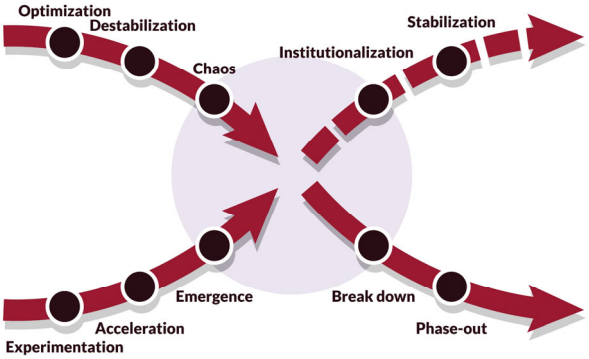

Fig. 2. X-curve [6]

3.3 Pathways

These heuristics describe the basic course of transitions. However, the actual path of the transition is also dependent on the type, intensity and timing of interaction [5]. For example, niches aren't mature yet while there is a demand from the regime. Or many niches are already available which can result in a fast and smooth transition. The same accounts for the landscape change, for each transition it can develop differently. As a result, different transition pathways can be distinguished. Geels and Schot [5] defined the different path possibilities; transformation path, dealignment and realignment path, technological substitution, reconfiguration pathway and a sequence of transition pathways. Each pathway describes the different interactions and, thus, gives insight into what is needed at what type of interaction to increase the velocity.

4. Differences & similarities

The different aspects as defined in the transition theory have been used to describe the current situation and expected path of the energy transition and transition towards a circular economy. This shows the differences and similarities on general transition level and the potential implications for companies.

4.1 Energy transition

The energy transition is initiated to reduce greenhouse gas emissions. The transition to renewable energy sources also overcomes the dependency on limited amounts of fossil fuel reserves left. A specific part of the regime needs to change, shifting in energy sources. There is also a focus on the reduction of energy use. By local optimization, even on company level, the specific interventions, as a result of fossil-based energy use, can be reduced [4]. Due to the variety of substitute energy sources and ways to reduce the energy use, multiple solutions can solve the specific problem. Because of the local optimization, companies can individually take their responsibility for the transition.

An important implication of the landscape pressure can be seen in the Paris Climate Agreement from 2015 [10]. All parties part of the United Nations signed the agreement to combat climate change by limiting the global temperature increase in this century to a maximum of 2°C compared to pre-industrial levels. The main method to commit to the agreement is the initiated energy transition. Also, the European Union (EU) and national governments defined their specific reduction objectives to stay in line with the agreements. E.g. The EU has a goal to reduce greenhouse gas emissions by net 55% in 2030 and be carbon neutral in 2050 compared to 1990 [11]. These agreements and reduction objectives show the political tendency regarding the energy transition.

The energy transition is already more mature since the new regime is starting to settle. Niches have developed, many of the required technological solutions have been developed and scaled up [12]. As a result of the known direction of the new regime, the economic benefits in the long term of renewable energy sources can be predicted and are increasing [13]. This increases the certainty of return of investment. A reinforcing effect is starting to develop due to the clear objectives stated on a national, continental [11] and global [10] level. Solutions for the energy transition are becoming mainstream and are suitable for the final new regimes. The initiatives and legislation are at this moment highly focused on the destruction of the old regime, e.g. by the EU ETS [14], and constructing the new regime, e.g. by innovation policy [9]. The application of these measures creates the turning point to stop investing in the old regime and start to institutionalize the new regime.

The transition follows a technological substitution pathway at this moment due to the availability of niches and continuously increasing landscape pressure. The transition pathway describes the change of a specific part of the transition that is mainly technological. For the pathway, it is expected that the regime will continue to be pressured by destruction measures to eventually phase out, which will likely happen in the energy transition. If no measures will be applied, the niches need to add more value in relation to the costs by themselves to replace the previously used technologies.

4.2 Transition towards a Circular Economy

The main problem a CE tackles is the resource availability and pollution. By keeping resources in the loop, fewer raw materials need to be extracted. This reduces the dependency on the available resources reserves. Furthermore, a CE prevents the emission of waste to the environment. The interventions that the transition towards the CE tries to mitigate originate from the complete value chain [4]. For a high-quality circulation of the materials in the system, a global system transition is required. In a system with circulating materials, there is an increased interdependence between the chain actors. Optimal functioning of partners is needed to make sure that resources are recirculated. The interdependence of different actors is expected to increase in a new regime.

The landscape pressure is less intense at this moment in time in the transition. The available objectives that are in line with this transition originate from the waste policies. Some national governments have already set specific objectives [15]. For example, the Dutch government has set the reduction objectives of raw material use to 50% in 2030 and 100% in 2050. Also, the EU objectives are in development in the *CE action plan* at this moment but not set yet [16]. The urgency of the transition isn't as generally accepted as is the case for the energy transition with global agreements. However, the pressure by the landscape is expected to increase over time especially as result of the resource scarcity.

The transition towards a CE is still at a start-up phase. The linear economy, the old regime, is optimizing itself by reducing its material consumption [12]. The emergence of the new regime is, still, at a somewhat low level. There is a lack of niches that could be part of the new regime. Also, most circular initiatives focus on the repair, recycling and reuse strategies. These activities were already mature before the emergence of the concept of a CE [4]. Governments focus on measures to restructure the current regime and construct a new regime [4, 8]. Destruction measures are only applied to very specific and harmful materials, e.g. by the single-use plastic directive [17].

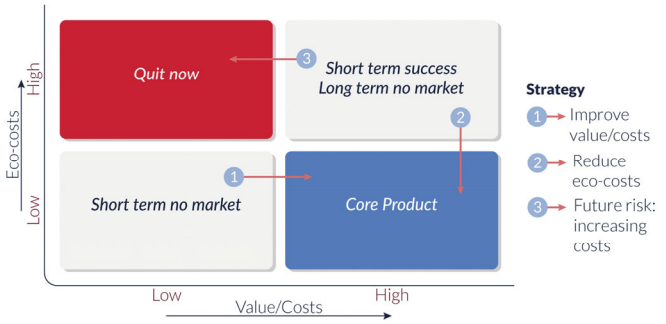

Fig. 3. Sustainable Business Strategy Matrix for products [18]

Due to the radical required change and lack of mature niches, the transition follows a dealignment and realignment path. The pathway describes the transition of a regime that needs to restructure. Destruction measures are essential to create an incentive to transition. Only constructing measures will not stimulate what is essential for a CE, restructuring the existing network [8]. The destruction measures help to clarify the transition path and are, therefore, expected.

4.3 Similarities

In both transitions, companies face a risk of business continuation when there is a lack of adaptation to a new regime. It's a result of the application of destruction measures to phase out the undesired effects of the linear economy. As described in sections 4.1 and 4.2, the application of legislative measures is expected for both transitions. This impacts not only the competitiveness of the specific company held responsible for the emissions. The complete chain can be impacted by the performance of partners negatively or positively. The eco-costs along the complete value chain should be reduced for business continuation. See figure 3 for the different product and service strategies depending on their environmental performance and overall added value.

5. Design brief for tool development

To support companies to cope with these transitions, different tools have been developed to reduce the environmental footprint. From the insights in the differences and similarities, an opportunity is identified to support companies in their initial steps for both the transitions. The opportunity is the design brief for a tool to be developed.

5.1 Analysis of available tools

To identify possible gaps in the available tools, 36 different tools are analysed. The focus of the tools is analysed and six different focus fields can be distinguished, see figure 4.

- First focus field tools such as environmental, social and governance reporting, corporate social responsibility and materiality assessment focus on the overall organization performance or how to optimize the organization. Only the performance of the company itself is relevant.
- The second focus field is the value created for the specific product within the organization, such as product design creativity tools.
- The third field is all about the assessment of what enters the organization, e.g. social responsible procurement.
- Tools in the fourth field focus on what flows out of the organization, e.g. the raw material passport.
- The fifth field is about the organizations and the primary activities across the value chain of a specific product or service, e.g. Porter's value chain analysis.
- Lastly, the sixth field describes the impact of the product or service life cycle, e.g. life cycle assessment.

5.2 Context for tool development

Incentives rise from the transition and form the context in which the developed tool should be positioned. Section 4.3 described the need to adapt to the new regime; in order for companies and their value chain to extend their existence beyond the transition. Otherwise, destruction measures will impact the competitiveness. Especially in the transition towards a CE where the interventions are a result of the actions of the complete value chain.

A high niche availability and local optimization in the energy transition result in an uncluttered transition pathway. Therefore, risk avoidance of high eco-costs is convenient by substitution of technology. However, in a CE there is an interdependence amongst all partners in the value chain for resource circulation. Substitutability of chain partners could jeopardize the long-term continuation of a circular business model. Value chain governance and alignment are required to create the circular value chain. The governance of chain partners can impact the formation of the circular business model positively or negatively. A high adaptive capacity of the complete chain is likely to increase the chance of a successful transition.

A paradigm shift is essential for companies to adhere to both transitions. The value created along the chain that contributes to the adaptivity is more important. The environmental performance and ability to adapt, describes the resilience of companies to stay relevant. Up till now, it is common that companies outsource what is required to mitigate risks. Only the directly created value for the short term is valued by the purchaser when outsourcing. Thus, the value that directly contributes to the business model. However, the solutions, especially for the transition towards a CE, go beyond straight forward technological substitution. Activities that contribute to the sustainable business model on the long term, the indirect value creation, are currently neglected. It's an investment in the adaptivity of the value chain on the long term. Therefore, the indirect value creation should be valued to stimulate the supporting activities for the transitions.

5.3 Tool development objective

The analysis of available tools shows a lack of focus by the tools on the supporting activities for adaptation across the complete value chain. While the overall value creation of chain partners should have the adaptive capacity to accomplish the

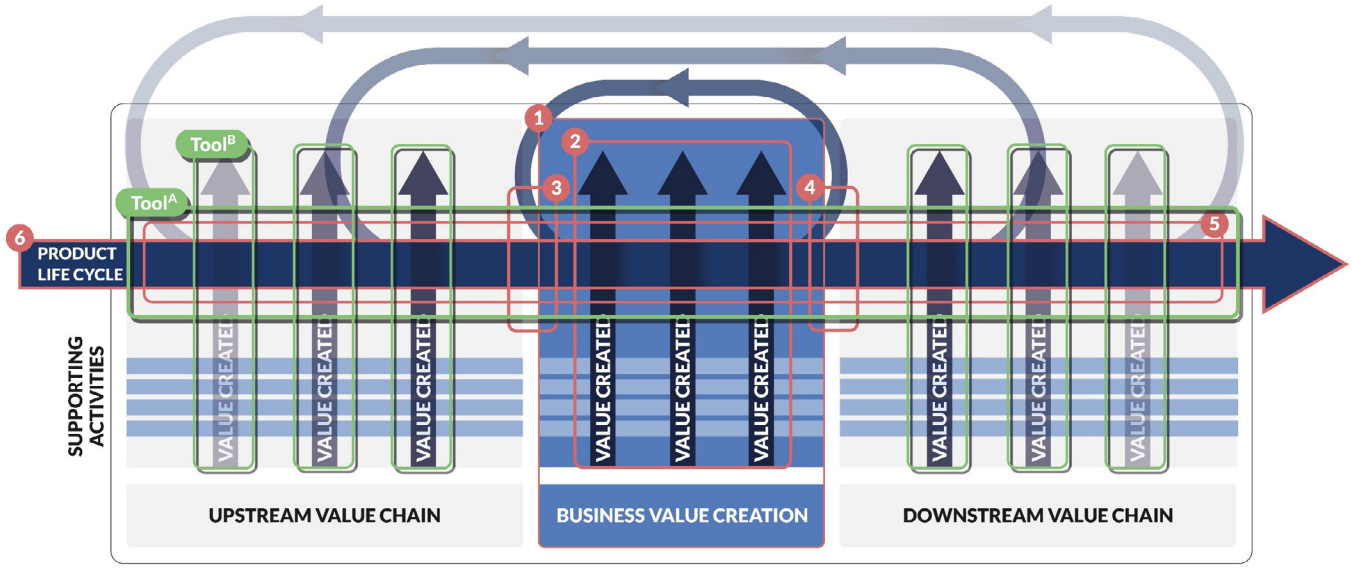

Fig. 4. Focus fields available tools (red) and new tool (green)

change. Considering all circumstances and existing tools, the main objective for new tool development is identification of the adaptive capacity in the context of the transitions along the value chain. And to eventually reconsider the value creation along the chain required to be adaptive together. This could result in the reallocation of resources across the value chain. Figure 4 presents the focus of the tool and compares the focus to the available tools. First, the value chain should be mapped to have an overview of the situation, see Tool^{A} in figure 4. Then insight needs to be acquired regarding the value-creating activities of the partners to eventually assess those partners on their adaptive capacity for the transition, see Tool^{B} in figure 4. Instead of only focusing on the direct created value, indirect value creation should increase in interest. Such a tool should incentivize companies to focus on and provide guidance for a multi-capital approach for value creation [19]. The approach to consider the creation of all types of value over the short, medium and long term. So, value financial, manufactured, intellectual, human, social and relationship and natural capital when doing business. The objective offers a new focus field as shown in figure 4. The principles for future tool development are defined that can provide support at this stage of the different transitions.

6. Conclusion

The analysis of differences and similarities of the energy transition versus circular economy identified a tool design objective to support companies in the different ongoing environmental transitions. Companies will eventually be affected by the different transitions one way or another. For the energy transition, each company can take responsibility for their adaptation. However, for the transition towards a CE, the value chain should collaborate for the global transition. Considering that the landscape pressure will continue to increase, companies are impacted by the combined performance of the value chain. Legislative measures are likely to be applied to reduce the competitiveness of products and services with a large environmental footprint. This affects the complete value chain and even endangers value chain continuation. These insights are used for the design brief of a supportive tool. Companies should shift their perspective from their value creation to a multi-capital approach for value creation. The tool should give insights into the adaptive capacity for the transition of partners across the value chain. A lack of adaptive capacity is a risk for continuation and should be reconsidered. The goal is to create a paradigm shift in companies and understand the importance of a multi-capital approach. The insights from the tool should support the companies to act upon the required overall adaptive capacity to eventually being able to transition.

Future research

As a result of the analysis, a first proposal for the tool is created. The tool doesn't indicate what companies have to do to transition but indicates the long-term risks of a non-adaptive value chain. It tries to stimulate companies to start communicating about those risks, what is acceptable, what actions are required and what other value-creating activities along the value chain are essential to be adaptive. For the application of such a tool, the complete value chain needs to acknowledge the shared responsibility to mitigate the risks and support the indirect value creation.

The first proposal of the tool assesses the so-called transition risks of partners across the value chain. The transition risks are identified by the relative environmental performance and perceived quality of governance to be adaptive. The assessment is executed per partner for the six environmental objectives as defined by the EU taxonomy [20]; climate change mitigation, climate change adaptation, pollution prevention, circular economy, sustainable use of water and marine resources and healthy ecosystem.

The environmental performance is used as an indicator since the amount of environmental impact indicates the extent to which the activity needs to adapt to fit the new regime. However, this is also dependent on the type of activity performed. Some activities are essential since they enable, contribute by themselves or support the transition. For some activities, it is inevitable to have more impact while they are

essential for our society. Considering the process of the transition, not all activities will perceive the same amount of transition risk directly. It depends on their contribution to the transitions and performance of competing value chains. Therefore, the same amount of environmental impact for different activities can result in different scores. The impact needs to be considered in reference to what is perceived as positive or negative for that particular activity.

The second indicator is the perceived quality of governance. It is expressed in a score that describes the adaptive capacity to the transition from the assessors' perspective. Therefore, it's more subjective compared to the assessment of the environmental performance. The assessment takes place from a specific perspective since the quality of governance is perspective-dependent. The assessor first will explicitly define what quality of governance, on all levels, is required and to what extent this is fulfilled. Together these two indicators reflect the risks of the transitions experienced by the assessor of the partners across the value chain.

Future research should, first of all, focus on the further development of the tool proposal. Till this point, it is a theoretical model that assesses the risks of a value chain for a transition, but still has some pitfalls. Furthermore, the application of the tool is not defined yet. The way to apply the tool in practice, the required information for the assessment and the level of expertise for execution have not been tested. Further development could help to improve the tool and identify a proper and convenient application. A case study of the improved tool could help to identify the application and test the extent to which the information supports companies in the transition to a future proof value chain.

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