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Facilitating Systemic Changes Towards Green Buildings: Developing Conceptual Frameworks of Socio-Technical Transitions

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Abstract

The building industry is a major contributor to various grand challenges e.g. climate change. Green buildings have been regarded by many as the solutions and opportunities to improve the environmental sustainability of the built environment. However, the development of green buildings in many countries is very slow, facing tremendous barriers technologically, culturally, economically and institutionally. How to understand and eliminate these barriers thereby effectively accelerating the development of green buildings presents a significant challenge for both researchers and practitioners. This paper aims to enrich the current efforts in promoting green buildings by proposing conceptual frameworks from a socio-technical transition perspective. The conceptual frameworks provide guidelines for analysing (1) factors affecting the socio-technical transition towards green buildings; (2) the transition phases towards green buildings; and (3) the actions of systemic changes to promote green buildings. The frameworks holistically demonstrate the complexity, struggles and potential strategies to effectively promote green buildings, which could offer references for policymakers, researchers and practitioners involved in green building development.

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Keywords: Sustainable development; Green building; Transition; Sustainability

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1. Introduction

Green buildings have received significant attentions worldwide as an effective approach to tackle climate change. Various studies (e.g. Zhang et al., 2011a; Shi et al., 2013) have investigated the drivers for and barriers to the popularization of green buildings. In these studies, although empirical information was collected, there is a lack of effort to explain the underlying theories. As a consequence, numerous factors have been identified for driving or impacting on, the uptake of green buildings, such as government policy, additional costs, awareness, stakeholder pressure and technology. However, few studies succeed in explaining how these factors interact with each other, thereby revealing the underlying mechanisms of transforming the construction industry towards green buildings. In response to the above gap of knowledge, this study adopts a unique transition approach, to propose conceptual frameworks of socio-technical transitions towards green buildings. Originating in the Netherlands, the research field of socio-technical transitions digs into historical transitions, such as that from horse-drawn carriages to automobiles, to explore how these shifts take place, thereby providing insights into contemporary sustainability issues. This approach highlights multi-dimensional interactions between the industry, technology, markets, policy and culture, capturing the complexity of systemic changes towards sustainability (Geels, 2012). The promotion of green buildings is indeed a transition process as it aims to substitute the existing conventional buildings with green buildings. It is imperative to understand, describe and promote this transition process, which is the aim of this study.

2. Conceptual frameworks of Socio-Technical Transitions towards Green Buildings

2.1. Factors affecting the socio-technical transition towards green buildings

The multi-level perspective on transitions (MLP) highlighted that the factors influencing transitions could be grouped into three levels, namely the niche, regime and landscape level. Specifically, niches are the locus of sustainability practices and innovations, i.e. the seeds for potential transitions such as renewable energy technologies. Regimes are the dominant rules and practices of socio-technical systems. These dominant rules stabilize the existing systems. The landscape level highlights the wider contexts, i.e. the stable long-term trend that influence niche and regime levels. For the building industry, a culture of mutual distrust and conservatism could be a landscape factor that is hardly be changed in a short period. The MLP emphasizes the transition is enabled by the dynamic interactions among the three levels. To transition the building industry towards sustainability, innovative sustainability practices and technologies at the niche level need to be empowered to gradually replace the existing unsustainable way of construction at the regime level, and the broader landscape level influences this process. The factors at each level could be further differentiated by their functions in transitions, i.e. being the drivers for or barriers to transitions. For instance, regarding the niche level, many factors could prohibit the formation of a shared vision for a green building industry, e.g. differences in subjective interpretations of values and responsibilities, few green leaders, lack of political vision and strategic planning, and sectorial fragmentation of building industry (Faber and Hoppe, 2013). However, there are also positive factors e.g. the effect of industry associations that could contribute to a shared vision for green buildings. Previous studies on MLP have highlighted that the interactions among the drivers for and barriers to sustainability at each level determined the potential of sustainability transitions.

However, even though the MLP conceptualize the three levels for analysing transitions, it does not provide many insights into the inner structure of the three levels. For instance, regarding the regime, Geels (2004) explained that "as the different groups share different rules, we may distinguish different regimes, e.g. technological or design regimes, policy regimes, science regimes, financial regimes and societal or user regimes." Similarly, the niche and landscape level could also be further differentiated into various components to provide a detailed understanding of the transitions dynamics. This work was not fully explored until Geels (2014), who proposed the Triple Embeddedness Framework (TEF) that indicates there are three main components in a transitioning system, namely the industry, the economic environment and the socio-political environment. The industry is interacted (co-evolved) with the economic environment, which consists of suppliers and clients selecting firms through economic competitiveness, and the socio-political environment, which consists of the government, media, NGOs and public selecting firms through social fitness. The industry itself consists of various related firms and their technology,

policy, and values. To transition the industry towards sustainability, the firms with higher sustainability levels in the industry need to be selected by the economic and social-political environment.

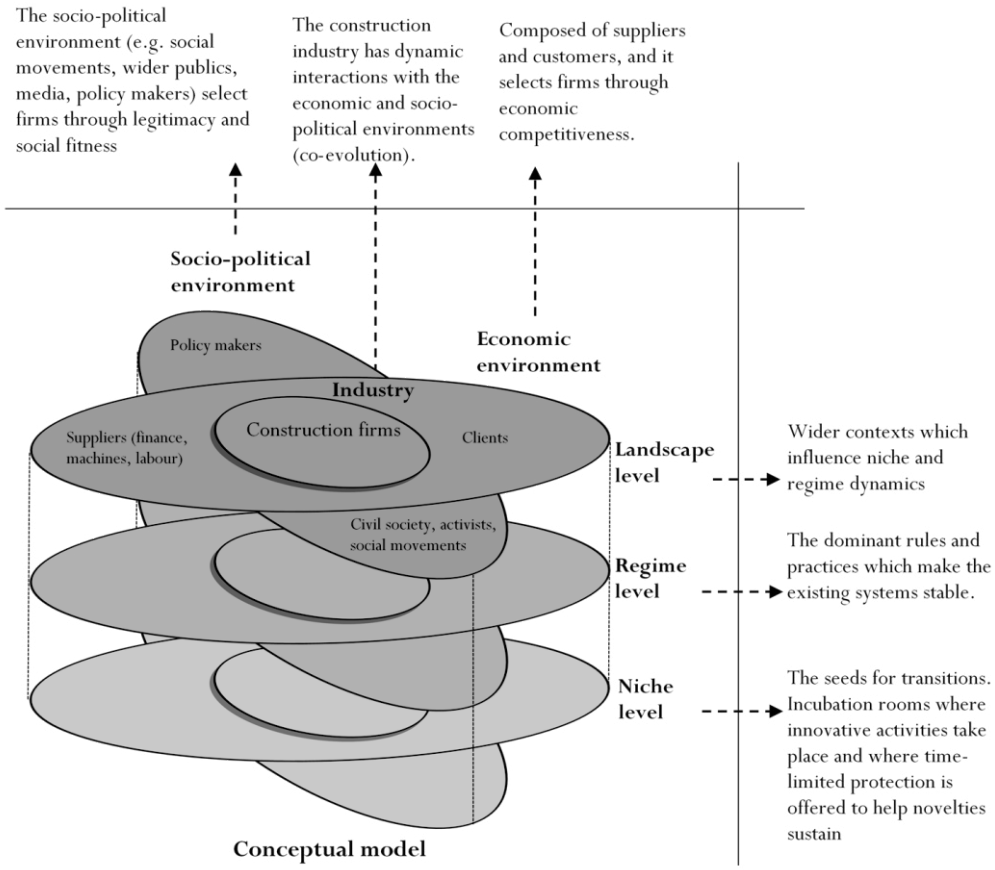

Fig. 1. Factors affecting the socio-technical transition towards green buildings.

Thus, the TEF provides the framework to further differentiate the niche, regime and landscape levels into various components. For instance, regarding the regime level, it has been argued that innovation in the building industry is mainly incremental driven by short-term cost reduction. This factor is clearly related to the industry. Similarly, it has also been argued that market demand for the building sector is homogeneous, with a focus on price tendering. Because traditional projects with lower costs tend to have stable cash flow, the financial actors are also primarily geared to providing loans for traditional projects with a small willingness to support innovative projects (Faber and Hoppe, 2013). These factors are clearly related to the economic environment. In terms of the socio-political environment, it has been discovered that policies for the building industry around the world usually focus on laggards rather than front-runners, i.e. policies are good at stipulating what firms should not do rather than encouraging firms to be visionary and leaders. Factors at the niche and landscape levels could be likewise differentiated according to their positions in the system, i.e. the industry, economic environment, and social-political environment.

Thus, built on the MLP and TEF, a conceptual framework for analysing factors influencing transitions towards green buildings is proposed, as shown in Fig. 1. According to this framework, the factors could be differentiated based on three features, i.e. levels, functions, and positions. For instance, factors such as technical difficulties, high initial costs, and lack of expertise and information associated with the green practices are barriers (function) in the

industry (position) at the niche level (level). Other factors could be similarly differentiated according to their level, function and position in the transitioning system. This framework offers a useful tool to classify the factors impacting green building development in a systemic way.

2.2. The transition phases towards green buildings

The previous section explains the factors affecting the transition towards green buildings, without delineating the transition process. The multi-phase concept of transition (MPC) indicates that there are four phases of transitions, namely predevelopment, take-off, acceleration and stabilization. The framework in Fig. 1. could be extended to show the transition phases as follows (Fig. 2.).

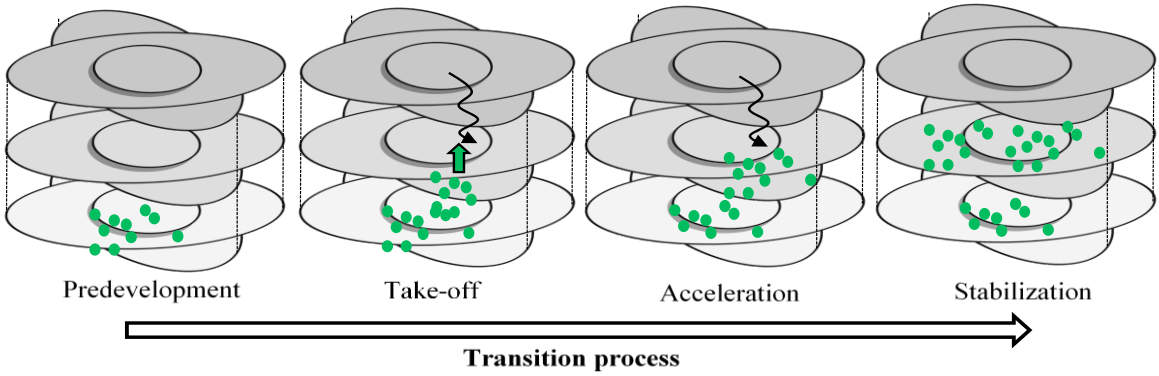

Fig. 2. The transition phases towards green buildings.

- Firstly, in the predevelopment phase the status quo does not visibly change, but actually there are many green innovations in niches. The green dots illustrate the green innovations in the conceptual framework. At this stage, some firms may feel the pressures generated by the niche-innovations but overall niche-innovations are not strong and the regime is quite stable.
- In the take-off phase, the innovations in niche become more mature and start to challenge the dominant practices in the regime. To successfully challenge the regime, innovations in niches must align into networks and succeed in becoming self-sustaining. In addition, developers feel increasing pressure to change the regime, especially from the socio-political environment. The TEF indicates that the affected groups and activists first articulate concerns and criticisms about a problem, and concerns spill over to public debates, which put pressure on policy makers, and then policymakers engage in debates, hearings and investigations and may introduce legislation to address the problems. Thus, the regime practices may start to shift under the increasing pressure from the socio-political environment. However, the TEF also implies that firms may adopt various strategies to deny the problems. Without obvious pressures in the economic environment, in take-off phase many firms may deny the problems or just conduct local search for temporary solutions such as downsizing. But some construction firms with long-term perspective may start to embrace sustainability innovations. The MLP indicates that landscape developments also put pressures on the regime. So, in the take-off phase, the three levels start to interact with each other.
- Then in the acceleration phase, the niche-innovations further experience performance improvement and become increasingly stabilized. By contrast, the regime practices become increasingly destabilized. The TEF indicates that when public debates and tough policies lead to changes in consumer preferences, thereby changing firms' economic environment, green innovation may become part of firms' core beliefs (Penna and Geels, 2012a). Existing studies on TEF indicates that pressures in the economic environment were the direct causes of destabilisation, i.e. economic considerations have the greatest influence on corporate strategy (Turnheim and Geels, 2012). Under increasing pressures from both the economic environment and socio-

political environment, firms start to understand that performance problems are structural rather than temporary and engage in a distant search for solutions such as strategic changes and radical technology innovation. So, in the take-off phase, niche-innovations will be adopted by increasing number of firms. The landscape keeps generating pressures on firms in the acceleration phase, facilitating the transition process.

- In the stabilization phase, niches are adopted by most regime actors, and thus the industry is transformed. Since the problems are solved by niche-innovations, the pressures from the economic and socio-political environments also weaken or disappear. Since the regime is transformed, the conflicts between regime and landscape also become weakened, and thus no obvious pressures present in the landscape level.

2.3. An action agenda of systemic changes to promote green buildings

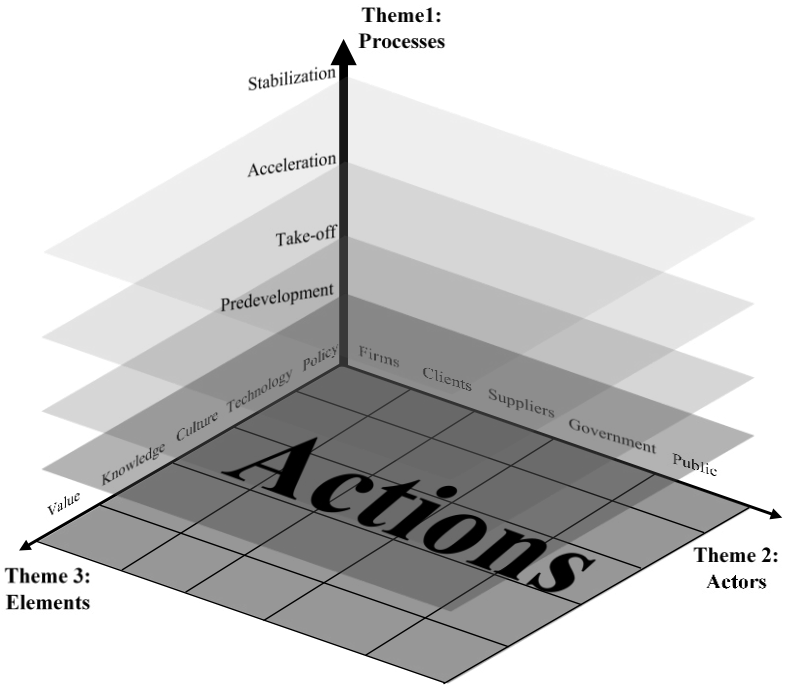

Fig. 3. An action agenda of systemic changes to promote green buildings.

In accordance with the framework in Fig.1, another framework was proposed to systemically illustrate the actions required to facilitate the transition towards green buildings. The first theme is transition processes. The MPC has proposed that transition consists of four phases, i.e. predevelopment, take-off, acceleration and stabilization. The holistic actions leading transitions towards green buildings should provide insights on facilitating transitions at every key process. For instance, how should the government change its incentive policies for green buildings in accordance with the different transition stages of the industry? Future research endeavours should reveal the key features and dynamics at every main stage of transitions, enabling the identification of strategies to influences each transition stage.

The second theme is actors in transitions. Fig.1 has identified that various factors impacting transitions are associated with different actors, e.g. the construction firms, suppliers, clients, government, etc. Stakeholders to the construction industry could all impact the sustainability transition of the industry, and thus the actions leading transitions should engage most of the key stakeholders, and offers guidelines that how these stakeholders should coordinate with each other to facilitate transitions. The TEF has preliminarily revealed these key actors form three interacting components, i.e. the industry, economic environment and social-political environment. Future research

should further explore the interactions among these actors in sustainability transitions. For instance, for the government, to empower sustainability niches in the most efficient way, how to allocate limited resources e.g. subsidies to different kinds of actors involved in the sustainability networks? How do different kinds of actors in a sustainability network interact with each other at every key stage of transitions?

The third theme is the changing elements in transitions. Transitions are sets of connected changes at various dimensions completed by different actors. To transition towards a green building industry, the policy, technology, knowledge, culture and many other elements linked to construction all need to be changed. Thus, the holistic approach facilitating transitions needs to demonstrate how to facilitate the co-evolution among these elements towards sustainability. For instance, how does the development of sustainability technologies co-evolve with the value system of the construction enterprises? What is the most efficient way to influence the deep-rooted regime and landscape elements e.g. the culture of conservatism?

The interactions among the processes, elements and actors form a space for analysing the various actions facilitating transitions, i.e. the actors need to take actions to change the elements following a certain process to facilitate the sustainability transitions at the industry level. Each group of actors could take actions to influence the various elements, and the actions may need to be adjusted in different transition stages. Thus, the holistic approach to facilitate transitions towards green buildings should provide guidelines on what actions should be taken by the various groups of actors to influence the different elements along with the different stages of transitions.

3. Conclusions

There is a lack of studies on systemically analysing the mechanisms of transitioning towards green buildings based on solid theoretical underpinnings. Built on the multi-level perspective (MLP) on transitions, the triple embeddedness framework (TEF), and the multi-phase concept of transitions (MPC), this study has proposed three conceptual frameworks for analysing the transition towards green buildings. The framework demonstrates the complexity, processes and potential strategies to effectively promote green buildings, which provides references for policymakers, researchers and practitioners involved in green building development.

Acknowledgements

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