



Durable policy facilitation of Sustainable Industrial Parks in China: A perspective of co-evolution of policy processes

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ARTICLE INFO

Article history:

Received 14 February 2018

Received in revised form

4 April 2018

Accepted 25 April 2018

Available online 26 April 2018

Keywords:

Policy facilitation

Co-evolution

Policy durability

Eco-industrial parks

Circular economy industrial parks

China

ABSTRACT

For some time, China has engaged in durable governmental facilitation of the development of Sustainable Industrial Parks (SIPs). This has materialized through two policy programs: one stimulating Eco-industrial Parks (EIPs) and one advancing Circular Economy Industrial Parks (CEIPs). Given their overlapping objectives, we conceive of the interaction of these programs as a process of policy co-evolution, seeking to understand in what ways they have reinforced or dampened each other, and consequently, its effects on the diffusion of SIPs in China. Using event-based analytical approaches, we show that 1) each program constituted a selection environment for the other, indicating that co-evolution took place; 2) the orchestration from powerful actors in the Circular Economy policy led to the change of types of co-evolution from the interference and potential competitions to symbiosis that brought about similar diffusion patterns of CEIPs and EIPs; 3) co-evolution was especially evident in the earlier periods of the policy processes, when policy actors strived to create a fit with broader social and physical environment; and 4) along with the established primary adaptation and shifted policy goals toward effective policy outcomes, the co-evolutionary dynamics became less intensive; and the combination of these factors eventually produced wide diffusion of SIP concept in diverse types of industrial parks.

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1. Introduction

For a number of years, China's government has actively facilitated the development of SIPs through nationwide policy programs of EIPs and CEIPs. Positive outcomes of these policy programs have been observed (e.g. Bai et al., 2014; Tian et al., 2014; Jiao and Boons, 2017), indicating the significance of governmental facilitation for developing of SIPs. Existing studies of Chinese SIP policies focus on either the CEIP policy or EIP policy, including reviews of policy progress (e.g. Shi et al., 2012; Su et al., 2013), evaluation of policy performance (e.g. Tian et al., 2014), critical analysis of policy instruments (e.g. Geng et al., 2012), and the evaluation of local SIP practices (e.g. Shi et al., 2010). These studies have generated a rich scholarly understanding of the dynamics of governmental facilitation of SIPs (Jiao and Boons, 2014).

However, to gain deeper insight into the dynamics of governmental facilitation, two issues need to be addressed further. The

first is how policies for long term developments such as SIP-development can be maintained over longer periods of time. The significance of governmental policy for the development of SIPs has been widely recognized (Costa et al., 2010; Geng et al., 2013; Deutz and Ioppolo 2015; Wang et al., 2017); however, we still lack insights into the ways through which policy actors continuously safeguard SIP policies against various undermining forces and adapt to changing institutional contexts (Jiao and Boons, 2017). We will use the concept of policy durability (Lockwood, 2013; Patashnik, 2008; Jiao and Boons 2017) to gain insights into this. The second issue is about how policy processes overlap and interact. Policies are complex and adaptive (Gerrits, 2008), and interactions between policy processes occur regularly (Byrne and Callaghan, 2014). The resulting complexity challenges our understanding of the dynamics of governmental facilitation in general, and the durable governmental facilitation of SIPs in particular. Theoretically, co-evolving policies can compete or support each other, thus undermining or reinforcing the development of SIPs. The co-evolutionary relation was noticed in a previous study of Chinese policy facilitation of CEIP (Jiao and Boons, 2017) where CEIP policy was analysed as an individual policy process with concentration on internal policy

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dynamics. Also, Zhang et al. (2010) observed some overlaps between the Chinese policies of CEIP and EIP. There is thus initial evidence that the two policies did not evolve independently but interacted as time passed. They share a common interest in SIP, but with a different emphasis, which created the space for their mutual influence. The co-existence of these two programs allows us to study the potential effects of co-evolution.

By addressing the aforementioned, we intend to make three contributions to the literature and to the policy efforts of SIPs and similar environmental policies. First, theoretically we focus on the co-evolution of SIP policies, which can improve our understanding of the co-evolutionary dynamics (e.g. how they co-evolve and types of co-evolution) of environmental policy efforts. Second, methodologically we take into account that cases which have been presented in isolation, are in fact a part of a wider web of processes, through developing the approaches of Event Sequence Analysis and Social Network Analysis of policy assemblage. Third, practically the effects of co-evolutionary policies manifest the consequences of having two policy programs with overlapping goals. It is of great importance to identify whether this is a waste of resources, or instead accomplishes more than that a single program could do.

In this article, we argue that co-evolution is one potential dynamic for creating (non)durable policy and can further influence the development of SIPs. It is built on a previous study of policy durability of CEIP in China (Jiao and Boons, 2017). In that study, the concept of policy durability is introduced and the framework of policy translation is developed, which consists of policy translation patterns and different types of policy durability. The framework is adopted to reveal the processes that brought about durable policy facilitation of CEIP in China. Building on that study, in this article we bring the concept of policy durability further by analysing 1) the co-evolution of policy processes of CEIP and EIP, as a dynamic of creating durable policy facilitation of SIPs; and 2) the impacts of their co-evolution on the overall development of SIPs in China. Our central research questions are:

- 1) How did the policy processes of EIP and CEIP co-evolve over time, and did their co-evolution undermine or reinforce the durable policy facilitation of SIPs in China?
- 2) What were the effects of the durable and co-evolving policies on the overall diffusion of SIPs in China?

The article is organized as follows. In section 2, we introduce the conceptual framework. In section 3, the methodology is described, and section 4 presents the results. In section 5, we identify types of co-evolution, and discuss the successive dynamics in the entire period of time, and connect the policy processes to the diffusion of SIPs in China. Section 6 presents our conclusions.

2. Conceptual framework

2.1. The relevance of durable policy facilitation for SIP development

Policy durability means stable, coherent and integral policy support and facilitation over a longer period of time for a given policy issue (Patashnik, 2008; Lockwood, 2013). It has particular relevance for the realization of SIPs (Jiao and Boons, 2017), due to the fact that the development of SIPs is a long term process. First, industrial symbiosis, the basis for a SIP, is a long term complex process of emergence, development, and decline of networks of by-products synergies and utility sharing (Boons et al., 2014, 2016). The work of Paquin and Howard-Grenville (2012), and Domenech and Davies (2011) supports this by distinguishing different phases of industrial symbiosis development. Second, a SIP cannot be achieved once at all, but is an outcome requiring sustained efforts. As

argued by Chertow and Miyata (2011), and Ashton (2011), unless tangible or intangible benefits show up when creating the symbiotic network, companies rely more on supply chains or their own industries, rather than on cooperation with their neighbors for obtaining resources. Due to these reasons, the key question for policy makers is inspiring or even “seducing” companies to implement the practices induced by a SIP policy. In addition, the policy implementation can encounter barriers, leading to superficial policy outcomes and even policy failures (Patashnik, 2008). For instance, EIP is sometimes merely regarded as a policy symbol and taken as a strategy of regional development and investment attraction, and often economic goals get more priority than environmental goals (Deutz and Gibbs, 2004). Also, inconsistencies and tensions can exist between generating private (i.e. individual company) profits and shared (i.e. collective performance of companies in industrial parks) performance (Posch et al., 2011). Hence, a long term governmental commitment is crucial to convince and support industries to make continuous investment of time, energy, and resource in SIP. Importantly, policy actors need to deliberately adjust goals and means in the long term policy process (e.g. Park et al., 2016; Chertow, 2007) to create a dynamic fit between policy and the progress of SIP practices, thus preventing the loss of interests of industries or firms dropping out of the industrial symbiotic network.

2.2. Co-evolution of policy processes

The question of achieving durable policy support for SIP development is complicated when two policy programs are simultaneously seeking to support this development. To understand the consequences of this we turn to complexity theory, and more specifically the concept of co-evolution (Byrne and Callaghan, 2014). The basic idea of co-evolution is that the fit between two or more coupled systems is created and maintained through reciprocal selections (Gerrits, 2011). Specifically, in coupled systems feedback loops carry information (e.g. changes of one system) that becomes the selection pressure for the other coupled systems. So, the reciprocal selection is “a simultaneous process that consists of continuous feedback loops between systems (Gerrits, 2011)”. The systems then make adjustments and responses. The reciprocal selection and mutual adjustment are circular processes that shape the future state of the systems.

The concept of co-evolution is originally about the relations between evolving biological systems (Odum, 1971), but has subsequently been adopted to interactions between social systems (e.g. Ruhl, 1999) and between social system and physical systems (Kallis and Norgaard, 2010). The major difference is that the social system actors seek to “steer” the direction and speed of evolution, while entities in the biological/physical system do not have that reflexive ability (Mulder and Van der Bergh, 1999; Edelenbos et al., 2008). This is because social actors can anticipate and respond to changes of the coupled systems.

Gerrits (2008) conceptualises policy processes as Complex Adaptive Systems. Policy processes become environment of each other, thus shaping the evolving trajectory of each other, i.e. they co-evolve over time. Co-evolutionary relations can be classified into three types (Odum, 1971): interference, parasitism and symbiosis.

- In an *interferential relation*, the interactions of systems mutually restrain the development of each other. For instance, the interactions of two policy processes mutually hinder the achievement of continuous policy development of each other.
- *Parasitism* occurs when the development of one system occurs at the cost of the other. For instance, the interactions between

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