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Building institutional capacity for industrial symbiosis development: A case study of an industrial symbiosis coordination network in China

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ABSTRACT

Recent research has examined how the concept of institutional capacity relates to the ability of organisations to deliver industrial symbiosis, and in particular how that ability itself can develop over time. One approach to developing industrial symbiosis has been to build a network of local bodies to work together to this end. Terming such a body an industrial symbiosis coordination network, this study innovatively applies institutional capacity building theory in the context of a Chinese eco-industrial park. It examines how the coordination network developed the expertise to encourage local companies to engage in industrial symbiosis. This research consisted of a qualitative study, including participant observation, semi-structured interviews and document analysis to analyse the development of an industrial symbiosis coordination network in Tianjin Binhai New Area. It is found that the network increased institutional capacity for local IS development by promoting relational links across organisational divisions and governance levels, and by increasing various types of knowledge for coordinating IS. The concept of institutional capacity building is shown to have cross-cultural applicability. Reflections on this study indicate that local government can play a vital role in building and maintaining an IS coordination network in the Chinese context, but that other bodies are also needed to mobilise institutional capacity for IS development.

1. Introduction

Industrial Symbiosis (IS) refers to one entity's under-utilised resource, including by-products, waste and energy streams becoming an input for another entity (Chertow, 2000; Deutz, 2014). The IS literature has identified certain canonical cases of IS in United States, Finland, Sweden, Denmark, Australia, South Korea, United Kingdom (Chertow, 2000; Mirata and Emtairah, 2005; Jacobsen, 2006; Park et al., 2008; Van Beers et al., 2008; Sokka et al., 2011; Rehn, 2013), and increasingly cases from China (Mathews and Tan, 2011; Yu et al., 2014a). Different approaches have been used to incentivise, encourage or facilitate the forming of IS relationships between companies on a local to national scale. For example, the eco-industrial park (EIP) development approach stresses green building design, integrated waste treatment facilities, or targeted tenant recruiting policies, to reduce waste emission within a park-level area (Deutz and Gibbs, 2008; Park et al., 2008; Shi et al., 2010). This method promotes IS through policies and planning to develop the supporting 'hardware' (e.g. infrastructure) of an EIP. However, whilst this hardware might provide the context for inter-firm relationships, in practice development of IS can be limited by contextual constraints beyond the EIP developers' control. In the US context, for example, locational factors contributed to challenges in recruiting complementary companies (e.g., Deutz and Gibbs, 2008). There are thus contextual constraints on what an IS project can achieve which are beyond its control.

Recent research has begun to consider how projects to promote IS and related cleaner production processes might learn from the processes they undertake and be able to improve their performance within those constraints (Boons and Spekkink, 2012; Spekkink, 2013; Van Hoof and Thiell, 2015). This has been done through the lens of the concept of institutional capacity building. Healey et al. (2003) used the term of institutional capacity (characterised by knowledge resources, relational resources and mobilisation capacity) to describe the ability of administrative and government organisations and agencies to respond to and resolve collective problems. These features are dynamic properties that can evolve

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over time as the policy process unfolds in its social, cultural and economic context. IS can be seen as such a process, likewise embedded in its context. Institutional capacity building has been applied to resource efficiencies (see below) in the context of IS generation in the Netherlands (Boons and Spekkink, 2012; Spekkink, 2013) and co-operation for cleaner production in Colombia (Van Hoof and Thiell, 2015). It has not, however, been previously applied to IS in China.

In China, EIPs have been a major national policy tool to promote resource efficiency in the context of the Circular Economy (CE[1]) policy (Geng and Zhao, 2009). There has been widespread interest amongst park management in promoting resource efficiency and other environmental activities in response to targets imposed upon them (Chertow and Ehrenfeld, 2012; Yu et al., 2014c). IS has been seen as a method by which to achieve the required resources efficiencies, and has been promoted in part through drawing upon experiences of other regions or countries (Geng and Zhao, 2009; Zhang et al., 2010; Shi et al., 2012).

One such pilot EIP is Tianjin Economic-Technological Development Area (TEDA), which collaborated with a UK environmental services company (International Synergies Limited, ISL) to implement a four-year funded IS project[2] in Tianjin Binhai New Area (TBNA, a broader area of TEDA) (Wang et al., 2012; Wang, 2013). The main purpose of the TBNA IS project was to encourage local companies to engage in the exchange of residues, and pinpoint future waste policy supporting sustainable industrial development (TEDA AC, 2009). However, ISL was only one component of several organisations assembled by TEDA administrative committee (AC), the local government, to provide collectively the information, knowledge, expertise and skills required to aid in IS development. We term this group of organisations and individuals an IS coordination network.

In this research, the forming and operating of an IS coordination network to implement the TBNA IS project is viewed as an institutional capacity building process for resolving economic, technological and policy problems regarding implementing IS activities in a Chinese industrial area. Here the institutional capacity building theory is drawn upon to analyse the level of knowledge and relational resources and mobilisation capacity developed by the TEDA IS network through examining the research question: How has the IS coordination network formed in TEDA contributed to the development of institutional capacity for IS facilitation?

The structure of this article is as follows: section 2 describes the theory of institutional capacity building and clarifies the concept of IS coordination network introduced in this research; section 3 illustrates research methods and geographical background of the case study; section 4 presents results for the research question based on the case study; conclusions and proposals for further work are provided in section 5.

2. Literature review

2.1. Institutional capacity building

2.1.1. Source of the theory

The concept of institutional capacity comes from the deliberative planning literature, referring to the ability of administrative organisations and agencies to respond to and resolve collective problems (Healey, 1998). According to Healey et al. (2003), urban governance initiatives can be supported by a reservoir of capacities built from knowledge and relational resources which need to be deliberately activated to release their potential. Therefore, the authors stressed the significance of networks or arenas where mobilisation takes place and the role of key actors in initiating and managing governance innovations. The term 'institutional capacity building' was thus proposed to examine the processes of developing ability amongst and between governance actors in a locality to shape pilot and innovatory initiatives, and the potential for such initiatives to shift past practices (Healey, 1998; Healey et al., 2003).

Generally, the concept of institutional capacity building in an urban planning network has been analysed in terms of knowledge resources, relational resources and mobilisation capacities that they draw upon and develop (Healey et al., 2003; Polk, 2011). Relevant definitions for institutional capacity building and the approaches that have been employed to study them are presented in Table 1. Most significant of these is the mobilisation capacity, i.e., the ability to draw upon the available resources to achieve a goal.

2.1.2. Institutional capacity theory in the IS literature

Boons et al. (2011) introduced the concept of the institutional capacity building into the IS literature as successful cases of IS implementation resonate with scenarios from the planning literature. That is, IS development in a given locality reflects the ability of relevant organisations to collectively address the issue. That ability can be characterised as the extent to which they have built up the elements of institutional capacity. In IS terms, these elements are the availability and sharing of *knowledge resources* for conducting IS activities (e.g., information on available residues and potential local uses); *relational resources* (e.g., a level of trust built up between companies and other relevant actors to assist the reduction of transaction costs); and *mobilisation capacity* (actors' ability to activate relevant firms and other parties to develop symbiotic linkages). These ideas recognise the 'embeddedness' (Granovetter, 1985) of IS in the social, cultural and economic context within which it is progressing (Boons and Howard-Grenville, 2009).

Significantly, institutional capacity is dynamic rather than a static condition. The elements of institutional capacity and the relationships between them evolve over time (Boons et al., 2011; Van Hoof and Thiell, 2015). Companies already engaged in IS-relationships, for example, have been shown to have increased willingness to explore additional IS-related possibilities (Paquin and Howard-Grenville, 2012), which could be seen as an enriching of the local institutional capacity for IS through the experience of IS. Boons and Spekkink (2012, 2013) have attempted to directly investigate the relationship between institutional capacity building and the generation of IS-relationships. In a quantitative study of 233 projects aiming to develop EIPs in the Netherlands, Boons and Spekkink (2012) found that of the three elements of institutional capacity, only mobilisation capacity is a factor affecting participants' perceptions of feasible options for action (the 'opportunity set'). The result underscores the pre-eminence of mobilisation capacity as the critical element in institutional capacity building (Healey et al., 2003); knowledge and relational resources are necessary, but not sufficient to bring about IS (Boons and Spekkink, 2012).

By contrast, Spekkink (2013) carried out a detailed process analysis of development of IS in the Canal Zone in the Zeeland province on the Netherlands over a 10-year time period. Institutional capacity for IS took a step forward when a funded project began to work alongside the individual effort of companies. This development helped to form a shared vision incorporating IS. Although the opportunities for IS have been fairly few, the

[1] Circular economy development refers to the promotion of resource conservation, cleaner production, re-utilisation, and environmental protection industries (State Council, 2005).

[2] Full name of the project is called *Implementing Industrial Symbiosis and Environmental Management Systems in Tianjin Binhai New Area* (Abbreviation: TBNA IS project).

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