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From transaction to transformation costs: The case of Polaroid's SX-70 camera

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Abstract

Innovation in a product's design can have significant implications for the organization of competencies across a production network. Currently, discussions on product designs and the distribution of competencies across production networks are based on transaction costs considerations. However, such a view does not consider the transformation costs that arise when competencies across a production network are reorganized because of design changes. We explore the nature of these costs by examining the dynamics associated with Polaroid Corporation's greatest innovation, the SX-70 camera. Our longitudinal study suggests that it is not costless to redraw the boundaries of a firm. In the SX-70 camera case, Polaroid's relationships with its important stakeholders were adversely affected resulting in a deterioration of its competitive position. From this study, we suggest that it is critical to consider the transformation costs involved with radical innovations in order to gain a more complete picture of change in systemic industries.

Keywords: Design; Modularity; Architecture; Innovation; Network

1. Introduction

An increasing number of products are being produced in a modular fashion across many organizations (Langlois and Robertson, 1992). Underpinning such production networks (Glasmeier, 1991) are design architectures that specify the location of interfaces among various modules (Baldwin and Clark, 2000, 2002). Any radical change in design[2] (Henderson and Clark, 1990) holds important implications for the re-distribution of competencies across the production network (Fleming and Sorenson, 2001; Glasmeier, 1991). Gaining insights into how such radical change unfolds especially given the emphasis on disruptive technologies (Christensen, 1997) is therefore of considerable importance.

Traditionally, discussions on how and why particular design architecture emerge and their impact on firm boundaries have been dominated by engineering design and transaction costs perspectives (Williamson, 1975). These perspectives consider the emergence of particular design architectures as being driven by functionality considerations at the design level and efficiency considerations at the production network level (Baldwin and Clark, 2000). The eventual architectures of a design and the organizational network that underpins its production are seen as the outcomes of decisions taken to minimize transaction costs.

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[2] Following Henderson and Clark (1990), an "architectural change" would shift the arrangement between two or more modules whereas a "radical" one would also change the modules themselves.

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However, by focusing on the creation of efficient boundaries at any given point in time, a transaction costs perspective tends to underplay both the historical contingences that shape innovation as well as the complex non-linear real-time processes that emerge as the innovation unfolds (von Hippel, 1990). As a result, such a perspective does not capture all the transformation costs involved during as architectures emerge or change. Noticing this lacuna, several scholars have called for a more dynamic understanding of the connections between architectures at the design and the production network levels (cf. Fixson and Park, 2007; Jacobides, 2005; MacDuffie, 2007).

Our paper attempts to address this issue. We do so by conceptualizing designs and production networks as embodying the interests of many different firms that are involved. Such a conceptualization of designs and production networks prompts us to consider the mutual interdependencies and tensions that arise across various transactional relationships over time. From this perspective, any architecture, even if it appears to be a logical outcome of efficient design choices, is only a temporary resolution of several interests that can easily be destabilized in a number of different ways thereby paving the way for radical change to unfold. As radical change unfolds, new contingencies may arise as the design and the production network within which it is nested interact and influence one another. A consideration of these dynamics makes it possible to capture important facets of radical change that are likely to be overlooked by traditional transaction costs perspectives.

We chose Polaroid's landmark innovation, the SX-70 camera, as an instance to explore such transformational dynamics. Introduced in 1972 by Polaroid, the SX-70 was hailed as one of the greatest technological accomplishments in the history of the industry (Life Magazine, 1972; Cordtz, 1974). However, in achieving this innovation, Polaroid was fundamentally transformed. Members of the network in which Polaroid was embedded reacted to decisions taken on technical and economic grounds, prompting Polaroid to introduce further changes in the design of its camera. In short, as the SX-70 innovation emerged, Polaroid had to incur significant transformation costs.

In developing our arguments, we first explain how the architecture of production networks is understood from engineering (Clark, 1985) and transaction costs perspectives (Baldwin and Clark, 2000, 2002). We then describe Polaroid's experience with its innovative SX-70 camera and film system, in particular how it led to dramatic changes in the architecture of the production network. Based on our in-depth study, we infer that, such changes in architecture entail significant transformation costs.

2. Theoretical overview

Designs have traditionally been conceptualized as bundles of components configured within a particular architecture to maximize functionality (cf. Ulrich and Eppinger, 2000). Such an understanding of designs has been at the heart of a growing discourse on modularity that builds upon Simon's (1962) notion of decomposability: the partitioning of a system in such a way that interactions of elements within a sub-assembly are greater than the interactions between elements across subassemblies. Such partitioning allows for not only physical but also cognitive division of labor (Simon, 1962; Rosenberg, 1982; von Hippel, 1990). This is because actors associated with designs need not know the workings of each part of the system. Instead, they are only required to possess knowledge that they need to complete the specific sub-assembly for which they are responsible.[3]

Decomposition, or modularity, is seen to be a rational response to complexity (Simon, 1962). By dividing up a complex system into pieces that connect with one another at pre-defined interfaces within a given architecture, modular designs are seen to evolve more quickly and effectively as compared to 'integrated' ones (Langlois and Robertson, 1992). For this reason, within the innovation literature, design architecture has emerged as a key parameter for designers and managers.

Building on Simon (1962), early perspectives on architecture were constructed predominantly from engineering considerations. A hierarchy of components was seen to be inherent in designs (Clark, 1985, p. 241). Clark (1985, p. 243) emphasized that, in this hierarchy, "one parameter sits at the apex, and is particularly trenchant in its impact on other aspects of the domain. Such concepts are 'central' or 'core' in the sense that the choices they represent dominate all others within the domain."

Extending this work to address the distribution of competencies across a production network, Baldwin and Clark (2002) pointed out that transactional interfaces

[3] Brusoni et al. (2001) recent work challenges this by suggesting that systems integrators may need to know more than what is theoretically required for the job.