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Coevolutionary cycles of convergence: An extrapolation from the ICT industry

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ABSTRACT

Convergence between technologies can be regarded as an increasingly emerging trend, and has received particular attention in the coming-together of previously distinct products and solutions within the information and communication technologies (ICT) industry. In previous research, the overall impact of the convergence phenomenon remains ambiguous. Whereas some scholars suggest convergence to be associated with disintegration, entry and growth, others relate the phenomenon to opposite effects, such as consolidation and shakeouts. This inconsistency in managerial conceptions on convergence formulates a need for an integrated understanding. Within a multi-case study approach, the convergence within ICT has been observed through examining the coevolution of actors in a converging environment, and patterns in innovation dynamics and managerial responses have been identified. In reflection with existing models of innovation cycles, a model for convergence innovation processes is elaborated and discussed. In particular, the reasoning within the ICT case set is transferred onto the currently emerging entrepreneurial activities in the intersection between nano- and bio-technologies (NBT), resulting in a comparison between ICT and NBT convergences, and deriving recommendations from a retrospective to a predictive context.

1. Introduction

The phenomenon of convergence occurs when innovations emerge at the intersection of established and clearly defined industry boundaries, thereby sparking off an evolutionary development with much broader impact. The resulting technologies, products and solutions do not only allow for novel applications and improved customer experience within both industries. Moreover, the coming-together of technological trajectories may yield outcomes which in their performance exceed the sum of their parts. As a consequence, established paradigms will be replaced by new ones, introducing new ways of solving problems that were already thought of as solved, and thereby disrupting and substituting rules of conducting business. In other words, convergence changes industries.

In recent industry developments within information and communication technologies (ICT), the convergence of technologies and underlying knowledge bases has induced a variety of industrial points of inflection. Whereas the phone line at some stage was used for getting into the Internet, the Internet can today be used for getting onto the phone. Hence, industry boundaries have become blurred, and innovation does not anymore take place within previously existing industrial silos, but rather between them.

Whereas the concept of convergence has represented a subject of attention within the telecommunications and information technology (IT) sectors for over a decade now, recent industrial trends suggest that the initially developed visions finally start to become operational, and that the convergence phenomenon increasingly is jumping "from drawing board concept into

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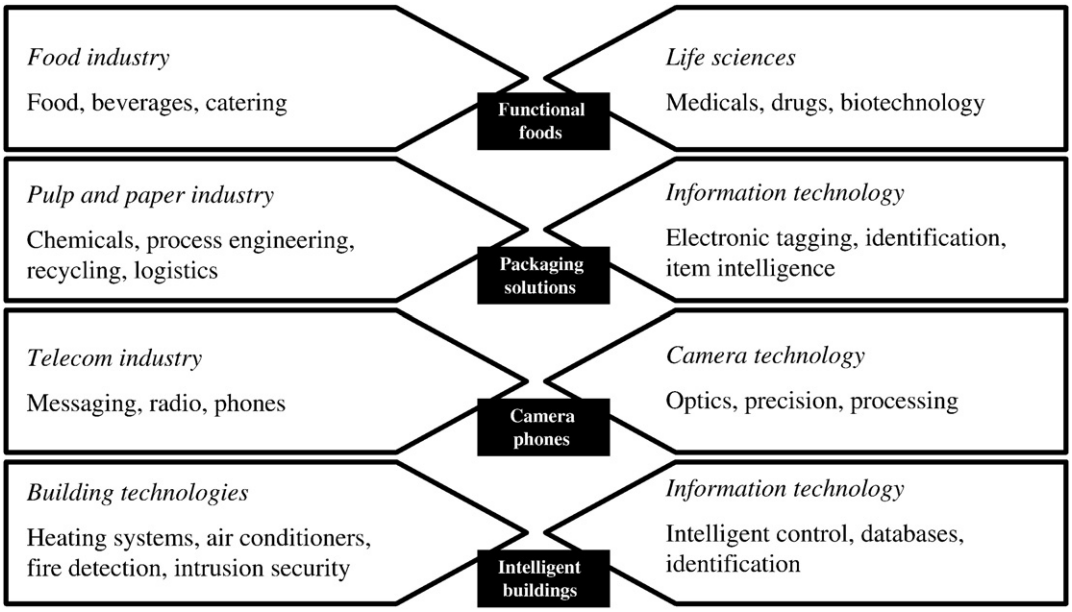

Fig. 1. Examples for convergent developments between industries.

consumers' hands, […] bringing users' media consumption closer to the nirvana of anything, anytime, anywhere" [1, p. 3]. Recognizing the pervasiveness of convergence around digital technologies, the world's largest annual trade show for information and telecommunications technology, CeBIT, was arranged in 2005 under the catch-phrase "digital convergence".

However, the promise of convergence is not only associated with opportunities and growth. As a consequence of the technological coming-together of both worlds, a variety of industrial consolidation activities have taken place, e.g., through mergers or acquisitions [2,3]. Furthermore, as business models tend to collide [4], convergence may even shake players entirely out of business [5,6].

After all, the phenomenon may not solely be limited to telephone and computing-related technologies. Fig. 1 depicts examples for convergent development trends between industries. In particular, emerging scientific advances in the intersection of microelectronics, material design, molecular biology, as well as complex chemistry result in nanoscale developments, which may trigger similar industry-changing phenomena. In such a context, estimates say that the cumulative market for converging info-, bio-, and nano-technologies could exceed $1 trillion within a decade [7].

1.1. Shortcomings of existing research

One may argue that after two decades of movement towards convergence, the result is still ambiguous [8]. In this view, this might be due to the *ex ante* definition of convergence on a theory level, which represented an idealization that was necessary to explain the implications of market developments opened-up by technological opportunity. Whereas there exists a broad literature base focusing on technological developments and business model opportunities rising from convergence [9–11], the association between convergence and innovation management can be regarded as a rather rarely identified subject [12–14]. In many cases, current approaches seem to mainly focus on symptoms—dealing with the new situation within the firm—rather than on examining the nature of the underlying mechanism for a proactive, participative approach to dealing with convergence. Additional exploratory and explanatory research is needed in order to understand convergence developments as a form of innovation, and in particular, to further relate the dynamics of convergent systems to respective dynamics of innovation processes.

There exist to some extent even contradictory conceptions on convergence effects, as on the one hand, convergence may lead to an explosive growth of new market entrants, while on the other hand, scholars argue that convergence consolidates the market. In particular, the phenomenon constitutes a major impetus for innovation and economic growth, while at the same time also causing market disequilibrium and firm mortality [15]. In particular, a variety of literature contributions indicate that vertical disintegration and value chain deconstruction are phenomena associated with convergence [16–18]. At the same time, the true opposite characteristic has been reported in literature as well, i.e., arguing that convergence is promoting a trend towards consolidation, vertically integrated companies, and alliances [19–21].

This inconsistency of reasoning on the one hand, and the consistency of *de facto* motivations for both types of effects on the other hand, give rise to the question whether this observed behavior might change over time. In other words, further investigation is needed for understanding to what extent both observations actually coexist, and whether the trajectory of disintegration and integration follows a certain sequential and temporal pattern.