TOWARDS AN ORGANIZATIONAL EXPLORATION OF TECHNOLOGICAL RESOURCES PORTFOLIO: A TECHNICOLOR HISTORY

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Abstract

We investigate the effect of technological resources recombination of the technological resource portfolio of Technicolor, formerly known as Thompson, a global leader in entertainment services and digital delivery. Mobilizing co-citation analysis, this paper explores the firm's 9,413 patents and their 60,000 citations over a thirty-one years period from 1980 to 2010. We show that the evolution of the technological portfolio is combinatorial and that the evolution of the technological portfolio is founded on specific technological resources which are the pivots of the evolution of the firm.

Keywords : Resource-Based View; Technological Innovation; Patents; Resources' Reconfiguration; Organizational Scope

JEL Code: L1, O34

1. Introduction

The question of resource recombination is a key issue debated in the strategic management research community for many years (Kaul, 2012). The Resource-Based View (RBV) conceives the firm as a collection of resources (Amit & Schoemaker, 1993; Barney, 1986, 1996; Dierickx & Cool, 1989a; Wernerfelt, 1984) and distinctive capabilities (Danneels, 2002; Teece, Pisano, & Shuen, 1997) that make it unique in its market. The main function of firms is to generate performance by combining resources in order to produce goods and services, to pay their owners and remunerate their employees (Durand, 2000). Nevertheless, the firm evolves and grows, which means that the resources' allocation and combination has to evolve too (Penrose, 1959; Teece et al., 1997). As a consequence, we argue in this paper that the organizational scope of the firm co-evolves with a recombination of the firm's technological resources portfolio.

Even if technological resources' reconfiguration is a strong topic, we still miss a more holistic perspective (Kaul, 2012). Empirical evidence in academic contributions are mostly centered on establishing correlations on cross sectional data, on the one hand; and focusing on the impacts of M&As and technological innovation (Capron, Dussauge, & Mitchell, 1998), on the other hand. Limits of the contributions can be overcome by mobilizing a holistic perspective, using longitudinal data analysis, over long periods, with a refined analysis of the firm's technological resources portfolio. This approach involves a data analysis at the firm's resources level. Hence, this paper investigates the evolution of the technological resource portfolio and what is the effect of technological resources recombination on the scope of the firm.

These arguments are investigated on a longitudinal analysis of Technicolor, formerly known as Thompson, a global leader in entertainment services and digital delivery. We analyze the firm's 9,413 patents and their 66,360 citations over a thirty-one years period from 1980 to 2010. We apply co-citation analysis to track technological roots over time (Narin, 1994; Small, 1985).

After the presentation of the main concepts of technological resource recombination and organizational scope (2), we detail the data and the methodological approach (3). We then present the results (4), before discussing them (5) and concluding (6).

2. Theoretical background

The RBV has its origins in Penrose' works (Penrose, 1952, 1959), later popularized by Wernerfelt (1984) and Barney (1986, 1991). The foundations of the RBV are based on the conception of a firm as a collection of resources (Amit et al., 1993; Barney, 1986; Dierickx et al., 1989a; Wernerfelt, 1984). In this conception, value is created by combining resources, thanks to the skills and abilities possessed by the firm, to conquer a market position which is unique, valuable and sustainable.

The conquest of this position conducts the firm to evolve and to adapt its resources' profile and its organizational scope. Nevertheless, resources are indivisible and semi-permanently present in the firm (Dierickx et al., 1989a; Dierickx & Cool, 1989b; Penrose, 1959;

Wernerfelt, 1984). This has a strong effect on the organizational inertia of the firms (Carroll, Bigelow, Seidel, & Tsai, 1996; Hannan & Freeman, 1977, 1984) and, as a consequence, on the ability of the firm to evolve its technological resources profile. Actually, this inertia implies latency between the evolutions of the markets' technological needs, through the consumers' behaviors, and the evolutions of the firm's technological resources portfolio. The firm is then mainly compelled to recombine its technological resources in order to redeploy them to produce Good & Services.

Resource recomnition is linked to the firm's main strategic process which is to formulate strategies in order to generate rents (Amit et al., 1993; Mahoney & Pandian, 1992; Makadok, 2001; Montgomery & Wernerfelt, 1988; Schoemaker, 1990). The implementation of these strategies is demonstrated by the identification and exploitation of resources (Teece et al., 1997). However, to combine and deploy its resources, the firm must first accumulate the greatest latitude of action as well as a wide range of responsibilities. The company must therefore identify the appropriate resources and then accumulate to combine them. But the accumulation of resources cannot by itself solve the problem of identification of potential synergies between these resources and their combination to generate rents. Knowledge is the backbone of this mechanism (Penrose, 1959: 56).

As shown by Wernerfelt (1984) and Barney (1991), in "first mover advantage" configurations, if resources were perfectly mobile, building competitive advantage through the deployment of resources would be instantly nullified by the copy of the combination resources. This is not possible because of causal ambiguity (Dierickx et al., 1989) and resource indivisibility (Barney, 1986, 1991). Since resources are regarded as being indivisible, they must be controlled in their entirety, though they can be mobilized only partially. Consider the case of a chemical engineer who has expertise in several technologies, but in his activity within the company manufactures a type of molecule in a specific way in terms of the resources used in his work. While this provides a competitive advantage to the firm, the firm finances more resources than it actually uses. It therefore has more potential strategies, but it accumulates more resources than it actually operates. In addition, this engineer will be better paid than an engineer with basic knowledge, as his market value is more important, thus representing an additional cost.

A translation of this resources' technological recombination has been addressed in the context of technological output leading to a modification of the firms' technological frontiers. RBV suggests that corporate scope is determined when firms diversify in order to capture the rents from strategic resources (Teece, 1982). Prahalad and Hamel (1990) argue that the firm's strategic intent is supported by its ability to leverage its core competences in new industries, outlining the new technological scope (Prahalad & Hamel, 1990). This analysis can be done through an exploration of patents portfolios. Following Tidd (2006), we argue that the patent portfolio is an adequate proxy of the technological boundaries of the firms (Tidd, 2006). The evolution of this portfolio is seen as an accurate representation of the evolution of the organizational scope of the firm (Kaul, 2012).

Recent contributions on resources reconfiguration have been mostly focusing on analyzing the impacts of change in firm resources on firm scope. For example, Capron et al. (1998) propose that acquisitions are key means by which firms can redeploy their strategic resources. Kaul (2012) outlines that analyzing the effects of innovation on corporate scope must include withdrawals from marginal business. All together these studies have favoured cross-sectional data with no specific focus on technological bundles of competences over time within a single company. We propose a new lens founded on a longitudinal analysis of the technological resources of the firm, based on the exploration of the firm's patent portfolio. We argue that such an approach would shed new light on how a firm is designing and recomposing its portfolio.

3. Methods

For the purpose of this study, we do a longitudinal analysis of Technicolor. Founded in 1883, this global leader in entertainment services and digital delivery records 3.6 Billions € in 2010. It appears as a suitable context to study resource reconfiguration and technological scope. Over a period of thirty-one year, Technicolor has witnessed various technological evolutions, acquisition and withdrawal. To study the scope over time we have analyzed the 9,413 patents issued between 1980 and 2010 by the US Patent & Trademark Organization (USPTO) to Technicolor.

Tableau 1:Firm's patenting activity descriptive statistics

	Number	Mean	Std. Dev.
Patents (1980-2010)	9413	303,65	143,85
Patents (1980-1989)	1842	184,20	50,89
Patents (1990-1999)	4713	471,30	110,13
Patents (2000-2010)	2858	259,82	65,93

From this patent base, we track back the 66,360 citations in order to assess the knowledge base on which the firm is building. Co-citation analysis has been widely known in the sociology field as a valid tool to undercover the underlying structure of a network (Narin, 1994; Small, 1985). Using R 2.10.1 software, we build the co-citation matrix from the 674 most cited patents. It is a 674x674 table. Each cell represents a similarity index between two patents. We then used Pajek 1.26 software and the Force Atlas algorithm in Gephi 0.8 to display the clustering of the co-citation matrix. We use the World Intellectual Property Office1 IPC (International Patent Classification)-Technology concordance table to identify technological areas.

4. Results

Figure 1 is showing the mapping of the co-citation network for Technicolor for the period 1980-2010, where thin circles represent semiconductors as thick circles represent audiovisual technologies.

[1] http://www.wipo.int/classifications/ipc/en/

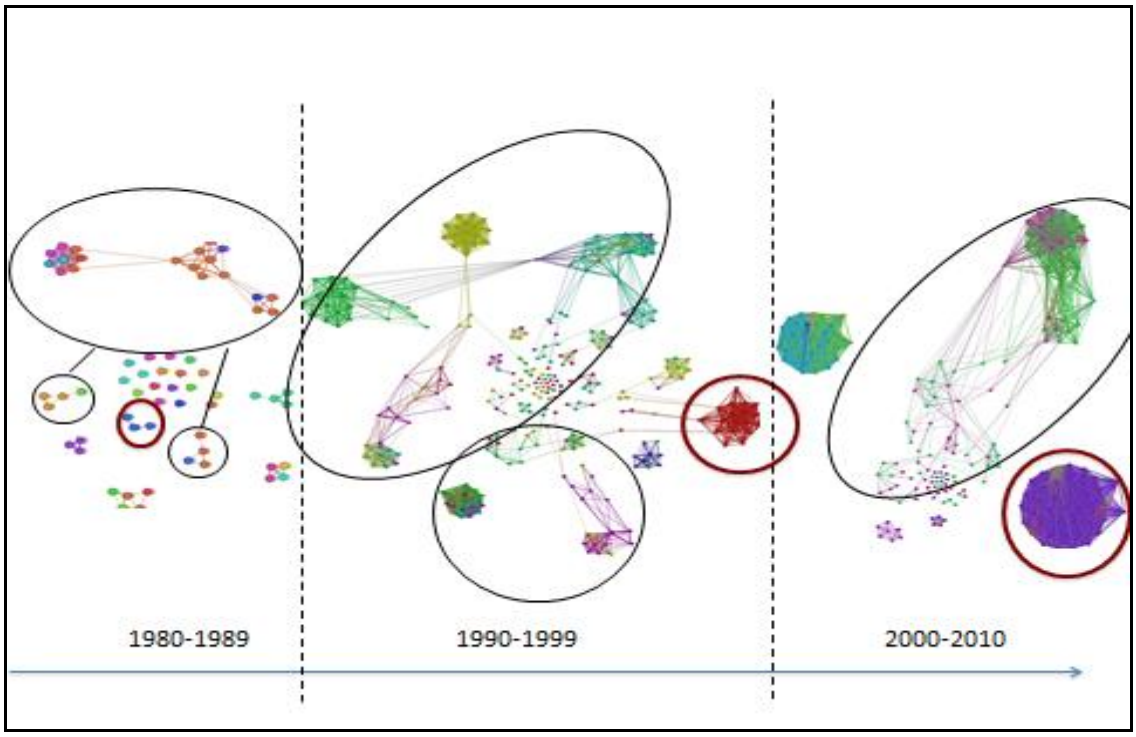

Figure 1: The structuring over Technicolor's technological portfolio (1980-2010)

The initial period (1980-1989) shows a fragmented technological base with an emerging dominant cluster around audiovisual technologies. The second period is highly fragmented with a disseminated portfolio of technologies alongside the pursuit of several technological paths around audiovisual technologies. The third period is showing a reconfiguration of the technological resources with a rationalization of the portfolio. Table 2 summarizes the top five technological base of Technicolor over the thirty-one years period.

Tableau 2: Top patent's citations technological area (in percentages)

1980-2010	1980-1989	1990-1999	2000-2010
Audiovisual (26.04)	Audiovisual (29.69)	Audiovisual (25.36)	Audiovisual (21.72)
Telecom (17.75)	Analysis Measurement (7.81)	Electrical Machinery (19.64)	Semiconductors (20.71)
Semiconductors (14.94)	Semiconductors (6.25)	Telecom (16.43)	Telecom (18.18)
Electrical Machinery (13.61)	Electrical Machinery (6.25)	Information techno (16.43)	Information techno (11.11)
Info techno (12.87)	Chemicals (6.25)	Semiconductors (14.64)	Transport (10.10)

Although we have a clear base across a few technological areas, the clusters shown in figure 1 are showing the convergence of technologies, displaying the very specific technological positioning of the firm. For example, Technicolor leadership in audiovisual technologies is grounded in the firm ability to merge technologies from different area (telecommunication, optics, and semiconductors among others).

5. Discussion

The longitudinal analysis of Technicolor's portfolio of technologies has implications for several features of our analysis of technological resources reconfiguration and organizational scope. Firstly, the evolution of the technological portfolio is neither additive (Schoemaker, 1992) nor hierarchical (Prahalad and Hamel, 1990) but combinatory. Secondly, the three-steps evolution seems to be driven by both external and internal factors as defended by Kaul (2012). The emergence of the audiovisual technologies follows the acquisitions of firms in the tv manufacturing industry like RCA. In the nineties, the firms is exploring various technological paths in pace with many innovations (telecommunication, information and digital technologies). Finally, the third period experiences disinvestment and a major strategic turnaround, centering the technological portfolio on audiovisual technologies. Thirdly, our analysis shows that the evolution of the portfolio is based on a limited number of pivotal technologies. For example, USPTO patent 5,450,019 on precharging output driver circuit is a key element to connect electrical machinery and telecommunication.

6. Conclusion

This paper examines resources configuration and organizational scope within Technicolor over the period 1980-2010. We use patents data and citations data to decipher the evolution of the technological portfolio. Results indicate that organizational scope is modified through resources reconfiguration and not mere addition, withdrawals or hierarchy. This resource reconfiguration is tracked back in both external and internal factors. Moreover, some resources act as technological pivot to leverage the firm's expertise across areas.

It is important to note some limitations of our study. First, our research is based on a single firm with an idiosyncratic history. Second patents are representing only a fraction of technological resources. Extending our history to firms in over industries and getting more details about the genealogy of technologies within firms would help understand the interaction between technological resources reconfiguration and organizational scope.

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References

Amit R, Schoemaker PJH. 1993. Strategic Assets and Organizational Rent. *Strategic Management Journal* **14**(1): 33-46.

Barney JB. 1986. Strategic Factor Markets: Expectations, Luck, and Business Strategy. *Management Science* **32**(10): 1231-1241.

Barney JB. 1996. *Gaining and sustaining competitive advantage*. Addison-Wesley Pub. Co.: pp. 570.

Capron L, Dussauge P, Mitchell W. 1998. Resource Redeployment Following Horizontal Acquisitions in Europe and North America, 1988-1992. *Strategic Management Journal* **19**(7): 631-661.

Carroll GR, Bigelow LS, Seidel M-DL, Tsai LB. 1996. The Fates of De Novo and De Alio Producers in the American Automobile Industry 1885-1981. *Strategic Management Journal* **17**: 117-137.

Danneels E. 2002. The Dynamics of Product Innovation and Firm Competences. *Strategic Management Journal* **23**(12): 1095-1121.

Dierickx I, Cool K. 1989a. Asset stock accumulation and sustainability of competitive advantage. *Management Science* **35**: 1504-1511.

Dierickx I, Cool K. 1989b. Asset stock accumulation and sustainability of competitive advantage: reply. *Management Science* **35**: 1514-1514.

Durand R. 2000. *Entreprise et évolution économique*. Belin.

Hannan MT, Freeman J. 1977. The Population Ecology of Organizations. *The American Journal of Sociology* **82**(5): 929-964.

Hannan MT, Freeman J. 1984. Structural Inertia and Organizational Change. *American Sociological Review* **49**(2): 149-164.

Kaul A. 2012. Technology and Corporate Scope: Firm and Rival Innovation as Antecedents of Corporate Transactions. *Strategic Management Journal* **33**(4): 347-367.

Mahoney JT, Pandian JR. 1992. The Resource-Based View Within the Conversation of Strategic Management. *Strategic Management Journal* **13**(5): 363-380.

Makadok R. 2001. Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Management Journal* **22**: 387.

Montgomery CA, Wernerfelt B. 1988. Diversification, Ricardian Rents, and Tobin's q. *The RAND Journal of Economics* **19**(4): 623-632.

Narin F. 1994. Patent bibliometrics. *Scientometrics* **30**(1): 147-155.

Penrose ET. 1952. Biological Analogies in the Theory of the Firm. *The American Economic Review* **42**(5): 804-819.

Penrose ET. 1959. *The Theory of the Growth of the Firm*. Basic Blackwell: Oxford.

Prahalad CK, Hamel G. 1990. The Core Competence of the Corporation. *Harvard Business Review* **68**: 79-91.

Schoemaker PJH. 1990. Strategy, Complexity and Economic Rent. *Management Science* **36**(10): 1178-1192.

Schoemaker PJH. 1992. How To Link Strategic Vision to Core Capabilities. *Sloan Management Review* **34**(1): 67-81.

Small H. 1985. Clustering the Science Citation Index using co-citation. *Scientometrics* **8**(2): 391-409.

Teece D. 1982. Towards an economic theory of the multi-product firm. *Journal of Economic Behavior & Organization* **3**: 39-63.

Teece DJ, Pisano G, Shuen A. 1997. Dynamic Capabilities and Strategic Management. *Strategic Management Journal* **18**(7): 509-533.

Tidd J. 2006. The competence cycle : translating knowledge into new processes, products and services. In *From knowledge management to stategic competence.* Tidd (ed.), Imperial College Press: London.

Wernerfelt B. 1984. A Resource-Based View of the Firm. *Strategic Management Journal* **5**(2): 171-180.

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