
Mergers and acquisitions, alliances and technology development: an empirical study of the global auto industry

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Abstract: Corporate-level strategy, which often includes Mergers and Acquisitions (M&As) and technological alliances, ultimately wishes to maximise corporate profits and innovativeness. This study examines how M&As and alliances affect internal technological innovation in the global auto industry. Hierarchical regression analyses reveal that M&As intensity is negatively related to innovation, whereas technological alliance is not associated significantly with internal innovation. However, Total Quality Management (TQM) implementation, such as the commitment of continuous improving philosophy, facilitates firms' internal innovation to a great extent. This study also tries to provide deeper explanations of these findings.

Keywords: Mergers and Acquisitions; M&As; technological alliances; Total Quality Management; TQM; internal innovation.

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1 Introduction

Horizontal strategy, which consists of Mergers and Acquisitions (M&As), alliance, strategic outsourcing and diversification strategies, seems to be a useful corporate-level strategy in this decade (Dorf and Byers, 2005; Hill et al., 2004). In most industries, such as automotive, pharmaceutical and computer industries, numerous integration cases have

increased the degree of industrial consolidation. International companies implement horizontal strategy, usually owing to the reported benefits of reducing costs, adding product value, avoiding price wars, increasing bargaining power and enhance organisational innovativeness (Burgelman et al., 2004; Prajogo and Sohal, 2006; Schilling, 2005). Among these horizontal strategic choices, M&As and alliance seem to be the most popular strategies in recent years. For example, UN estimates report that 40 to 80% of worldwide Foreign Direct Investment (FDI) was in the form of M&As between 1998 and 2003. In 2001, M&As accounted for 78% of FDI (Hill, 2006). Firms make M&As because those acquired firms have uncommon strategic assets, such as customer and supplier relationships, distribution systems and technological know-how. The acquirers also believe they can increase the efficiency and reduce the production cost of the target firms by transfer technology and management skills.

Automobile is an intensive M&A industry. In the last decade, a wave of M&As and alliance between global carmakers resulted from increasing economics of scale and scope and reducing the cost and risk of R&D projects. Ford, for example, owns Mazda, Aston-Martin, Jaguar, Lincoln, Land-Rover, Mercury and Volvo; Volkswagen owns Audi, Bugatti, Lamborghini, Bentley, Seat and Skoda. Mercedes-Benz and Chrysler merged in 1998, then bought Mitsubishi in 2000, and sold it in 2003; Hyundai bought Kia in 1999; and Renault bought Nissan in 2000.

Concurrent with the heavy M&As and technological alliances activity, firms' technological development and internal innovation has become increasingly important as a way to generate new ideas in organisations. Unlike organisational external innovation, that can also include the product or process outside the organisation (Woodman et al., 1993), internal technological innovation refer to the development and introduction of new products and processes created inside the organisation (Hitt et al., 1996, p.1088). The technological changes and keen global competition have increased the importance of internal technological innovation because it can help firms to achieve and maintain competitive advantages. Moreover, internal innovation has become crucial for value creation in many sectors (Hitt et al., 1994). Unfortunately, integration strategies often have different influences on firms' innovative capabilities in real world practices (de Man and Duysters, 2005).

While some studies suggested that M&As lead to outstanding internal innovation performance (Bresman et al., 1999; Larsson et al., 1998), others suggested the opposite (Jones, 2005; Morgan, 2001). Thus, to gain a clear understanding of the relationship between M&As and firms' internal innovation, this study offers the argument that M&As enhance little innovativeness in auto industry. Furthermore, this study also divided firms' technology acquisition path into two categories: the more technological alliances or cooperation means the emphasis on the acquisition of technology using external R&D. On the contrary, better Total Quality Management (TQM) implementation, such as the commitment of continuously improving philosophy, correlates with an emphasis on the acquisition of technology using internal R&D. This study also argued that different types of technology acquisition path has different influence on internal technological innovation. The rest of this study is organised as follows. The following section establishes main hypotheses from past literature. Sections 3 and 4 then conduct an empirical investigation to test the research hypotheses, and then analyse the findings. Finally, Section 5 presents some main conclusions and directions for future research.

2 Literature review and hypotheses setting

2.1 Mergers and acquisitions and internal technological innovation

Although M&As have been objects of study for a long time, there is little agreement as to the relationship between M&A and technological innovation (de Man and Duysters, 2005). From perspectives of knowledge management, M&As may increase R&D budget of firms involved and allows them to tackle larger R&D projects (Bresman et al., 1999). In this way, larger R&D budgets can facilitate the activities for technological innovation. Inter-organisation cooperation rather than competition thus create the value of knowledge within networked firms (Lin and Chen, 2006). Furthermore, companies with complementary knowledge can integrate their specific advantages to develop new products and technologies that are not accomplishable for a single company (Gerpott, 1995). This has two effects: either an innovation emerges or an innovation is realised faster than without collaboration (de Man and Duysters, 2005). As a result, M&As seem to enhance firms' performance of external innovations.

On the other hand, M&As face some barriers to internal technological innovation from theories of transaction cost and organisational behaviour. Acquisitions usually entail high transaction costs (e.g. negotiating cost, bidding cost, and monitoring cost) that result in acquirers not realising profits from acquisitions (Hitt et al., 1996). One of the important transaction difficulties is 'bounded rationality' (Jones, 2005) that explains the high complexity and uncertainty within acquisition negotiations. Acquirers may not easily predict potential gains between the acquiring and acquired firms' assets. This uncertainty may lead to problems in integration processes and harm internal innovation efforts because economies of scale is often lower than predicted. Another negative effect is that the acquisition processes usually absorb much managerial time and energy. M&As require extensive preparation, negotiations, analyses and evaluations. During this process, the attention of top managers may be diverted from internal activities such as developing new products and innovative technologies (Hitt et al., 1990). A third negative effect is that activities in acquired firms usually enter a state of 'suspended animation' (Hoskisson et al., 1991). Top managers of acquired firms are often disinclined to make long-term commitments of investment in R&D and technological innovations. Therefore, top-level managers in both acquiring and acquired firms usually strengthen risk aversion in the acquisition processes.

A fourth negative effect is the increased use of debt. Doing so increases debt cost and diverts investments from internal R&D development (Hitt et al., 1996). Debt holders usually set rules to forbid highly risky R&D projects. A fifth effect is that M&As mean less competition in the market. This will reduce the speed of innovation in intensive M&As industries (Morgan, 2001). Finally, the failure rate of internal technological innovation in general is high, and the length of time required for innovations to produce returns is long. This problem has emerged and increased in recent years because rapidly technological change and keen global competition have shortened the length of time that firms have to achieve returns on their innovation projects (Bettis and Hitt, 1995).

The preceding arguments suggest that most studies supported the negative effects of internal innovation by M&As. As a result, this study expected a negative relationship between M&As and internal technological innovation.

H1: There is a negative relationship between M&A intensity and internal technological innovation.

2.2 Total quality management and internal technological innovation

In the last decade, various firms have adopted technological innovation to increase their competitiveness, market-share and profit in the marketplace. TQM is crucial as a strategic part of technological innovation in the automotive sector. The promise of TQM is that organisations will produce more efficiently and precisely by reducing variance and increasing process control, by using TQM tools (Benner and Tushman, 2002, 2003). Academic studies have investigated relationships between TQM and organisational performance in some industries (Cole, 2002; Ittner and Larcker, 1997), and most research supported that TQM tools enhanced firm's management of technological innovation. Referring to the Dutch construction industry, Bossink (2002) revealed that TQM supported the management of innovation, and similar results have also been showed in the oil industry (Keogh and Bower, 1997).

TQM is an important element of process management because its associated techniques focus on increasing efficiency by coordinating all departments and employees in the company. Emphasising on functional coordination, rationalisation of procedures and repeating of routines, TQM is a major activity for reducing the number of defective, over-variant products (Laosirihongthong et al., 2003). Furthermore, global automotive firms emphasise management of advanced and innovative manufacturing processes that strengthens firms' efficiency and effectiveness by coordinating all manufacturing functions and members. The TQM philosophy consists of continuous improving, the entire personnel participating and the seeking for consumer satisfaction (Stevenson, 2002). These are all helpful to internal innovation activities for the manufacturing firms. Thus, this study expects the use of TQM to promote more internal technological innovation.

H2: There is a positive relationship between TQM and internal technological innovation.

2.3 Technological cooperation and internal technological innovation

Alliances or cooperative agreements can ease a number of transactional cost (Schlie and Yip, 2000). Previous studies usually suggest that technological cooperation is one of the important sources of innovation. Firstly, cooperative agreements may reduce the risk of large R&D projects. The integration of firms' knowledge may also increase innovation performance among alliances (de Man and Duysters, 2005). Secondly, all firms try to reduce R&D cost by spreading the cost over a number of cooperators. This will also lead to a significant reduction in lead times (de Man and Duysters, 2005). Finally, in contrast with the difficulties of M&As, technological alliances can focus on a specific field of knowledge (Kotabe et al., 2003). Thus, this study expects the technological cooperation to promote more internal technological innovation.

H3: There is a positive relationship between technological cooperation and internal technological innovation.

3 Research methods

3.1 Sample and data collection

This study conducted an empirical investigation to test

- 1 is there a negative relationship between M&As and internal technological innovation
- 2 is there a positive relationship between TQM and internal technological innovation
- 3 is there a positive relationship between technological cooperation and internal technological innovation.

Data were collected at industrial and organisational levels. The sample is made up of the 11 largest global car groups (GM, Toyota, Ford, Renault/Nissan, VW, Daimler-Chrysler, PSA, Hyundai, Honda, Fiat, and BMW, see Table 1) between 2000 and 2005. We have 51 observations during these years. These automotive groups account for all significant global automakers (e.g. GM owns Buick, Chevrolet, Cadillac, GMC, Hummer, Opel, Pontiac, Saab, Saturn, Vauxhall and Daewoo in 2005). This investigation excluded firms operating only in local markets. Data on cooperative car groups established were available from the United Nations Industrial Development Organization (UNIDO). Quality management performance for each firm was obtained from the Initial Quality Study (IQS) of J.D. Power and Associates. Patent data were obtained from the US Patent and Trademark Office (USPTO), the European Patent Office (EPO) and the World Intellectual Property Organization (WIPO). Additional data were collected from Moody's Investors Service and The World's Car Manufacturers. In order to clarify the research problems stated above, the measures of associated variables should be well-defined in advance.

Table 1 Global car groups: annual worldwide sales (million cars) and market capitalisation (billion dollars) in 2005

<i>Car groups</i>	<i>Annual sales</i>	<i>Market capitalisation</i>
GM	9.2	12.0
Toyota	7.4	176.0
Ford	6.8	14.6
Renault/Nissan	6.1	54.5
VW	5.2	28.0
Daimler-Chrysler	4.0	57.9
PSA	3.4	11.7
Hyundai	3.3	23.4
Honda	3.2	56.0
Fiat	1.7	11.2
BMW	1.3	24.9

Source: UNIDO and The World's Car Manufacturers, 2005.

3.2 Independent variable

3.2.1 Internal technological innovation

Unlike organisational external innovation, that can also include new product or process outside the organisation (Woodman et al., 1993), internal technological innovation refer to the development and introduction of new products and processes created inside the organisation (Hitt et al., 1996). Patent is regarded as an objective measure of internal technological innovation (Abernathy and Chakravarty, 1979; Benner and Tushman, 2002, 2003; Sørensen and Stuard, 2000). Considering each firm's internal technological innovations, this investigation collected data on global automotive technological patents, including data from the USPTO, the EPO and the WIPO. The category 'patents' measures the number of new technologies developed by a single automaker in each year (2000–2005). For a car group containing several subsidiaries, only the dominant automaker's patents were included. It is transparent since smaller automakers might belong to different car groups in different years.

3.3 Dependent variables

3.3.1 Mergers and acquisitions intensity

Mergers and Acquisitions Intensity (M&A intensity) was operationally defined using number of M&As completed since 1999. Data were available from the UNIDO and Moody's Investors Service. This measure is similar to that used by Hitt and his colleagues (Hitt et al., 1996).

3.3.2 Technological cooperation and TQM implementation

These two variables describe the automaker's technology acquirement strategy. The more technological cooperation means the emphasis on the acquisition of technology using external R&D. On the contrary, fewer quality problems (better TQM implementation) correlates with an emphasis on the acquisition of technology using internal R&D, such as the commitment of TQM, or continuously improving philosophy (Khalil, 2001). In this study, technological cooperation indicates the number of a motor group's technological cooperators in each year. Data were available from the UNIDO and Moody's Investors Service. Concerning the measure of TQM, for simplicity and objectivity, this study adopted the general error rate (problems) in products sold and used by consumers (Cole, 2002; Tuckman, 1994). Information on each automaker was obtained from the 2000–2005 IQS of J.D. Power and Associates. The IQS was based on responses from over 62,000 purchasers and lease-holders of new model-car and trucks, surveyed after 90 days of ownership in the US market.

3.4 Control variables

3.4.1 Market capitalisation, annual sales and new market development

Horizontal integration strategy in global auto industry can be categorised into three directions. Some organisations wish to create their corporate value by increasing their market capitalisation, some organisations wish to implement differentiation strategy

by increasing their market share and enlarging their product line and the others wish to reduce their production costs by entering new markets. These three variables describe the degree of a motor group's horizontal integration strategy implementation (Khalil, 2001; Rao and Drazin, 2002). These strategic variables were suggested to influence firms' innovation performance in the past studies (Burgers et al., 1993; Isely and Simons, 2002; Kotabe et al., 2003). 'Annual sales' indicates the number of cars sold by a car group in each year between 2000 and 2005. In this study, market capitalisation and annual sales of all car groups were collected from The World's Car Manufacturers. 'New market development' indicates the number of foreign subsidiaries owned by the automakers in each year. Data were attained from Moody's Investors Service.

4 Findings

This study used hierarchical regression analyses to test the research hypotheses. Before analyses, all variables were standardised to admit comparisons among coefficients estimated in different units. Then, refined diagnostics were used to verify the adequacy of the regression models. Normal probability charts were applied to confirm the normality of the error terms; and residual plots confirmed the constancy and independence of errors. The average Variance Inflation Factor (average VIF) associated with each coefficient of regression model 2 was 1.23. All of the VIFs of model 2 ranged from 1.05 to 1.39, revealing the insignificance of multicollinearity. Moreover, the Dubin-Watson test statistics (2.03) also supports the assumption of random error terms. The correlation matrix in Table 2 implies that patent is strongly related to market capitalisation ($r = 0.77, p < 0.01$), M&A intensity ($r = -0.60, p < 0.01$), and quality problems ($r = -0.82, p < 0.01$). Market capitalisation is related to M&A intensity ($r = -0.40, p < 0.05$) and quality problems ($r = -0.70, p < 0.05$); annual sales is related to M&A intensity ($r = 0.57, p < 0.05$) and new market development ($r = 0.55, p < 0.05$).

Table 2 Correlation matrix

Variable	1	2	3	4	5	6
1. Patent						
2. Market capitalisation	-0.77***					
3. Annual sales	-0.10	0.27				
4. M&A intensity	-0.60***	-0.40**	0.57**			
5. Technological cooperation	-0.39	-0.27	0.19	0.37		
6. Quality problems	-0.82***	-0.70**	-0.32	0.17	0.11	
7. New market development	0.13	0.32	0.55**	0.20	0.38**	-0.17

Note: Two-tailed tested, $n = 51$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3 presents a series of regression models associated with internal technological innovation (patents). In model 1, market capitalisation ($b = 0.33, p < 0.05$) is positively related to patents issued by car groups. This also verifies the impacts of integration

strategies on firms' internal innovation. In model 2, M&A intensity ($b = -0.40, p < 0.05$) and quality problems ($b = -0.61, p < 0.05$) are strongly related to internal innovation. Adding three independent variables, M&A intensity, technological cooperation and quality problems, increased the multiple squared correlation coefficient (R^2) by 46% over that in model 1 ($\Delta R^2 = 0.46, p < 0.001$). These results indicate direct effects of M&A intensity (negative) and TQM implementation (positive). However, the insignificance of the coefficient of technological cooperation seems to indicate no relationship between technological cooperation and firms' internal innovation. The results revealed that M&A does not seem to enhance innovation; however, TQM will facilitate firms' internal innovation performance in the automotive industry. Thus, there are supports for Hypotheses 1 and 2, whereas no support for Hypotheses 3. Other findings of this study include:

- *Different dimension of integration strategies have different impacts on corporate technology development:* 'Market capitalisation' is positively related to corporate issued patents ($b = 0.29, p < 0.1$, Model 2). A firm which keeps increasing its value created and core competences tends to enlarge its market capitalisation, and finally facilitates internal innovativeness. 'Annual sales' is not related to producing patents. Increasing annual sales helps raise market share, which usually causes a price war or an increased focus on market factors, but does not seem to improve technical developments. M&A intensity is negatively-related to technical innovation ($b = -0.40, p < 0.05$). For top managers, increasing brands or subsidiaries usually means that they should pay more attention to intergroup integration and negotiation. From a perspective of technical standard and community components, engineers should be concerned with cross-system manufacturing, instead of technical innovations.
- *The effects of mergers and acquisitions:* M&As intensity is negatively-related to patent generation ($r = -0.60, p < 0.01$); is negatively related to market capitalisation ($r = -0.40, p < 0.05$); and is positively-related to annual sales ($r = 0.57, p < 0.05$). To implement strategies of M&As, therefore, is beneficial to enlarge market shares and seeking technology partners. However, it is not favourable to corporate value creation or new technology development.
- *The intersection of integration strategy with technology development strategy of firms:* Considering the three directions of integration strategy (increasing market capitalisation, increasing market share and developing new markets.) and the two categories of technology acquisition paths (technological cooperation by using external R&D and better TQM implementation by using internal R&D), the results indicated that market capitalisation is strongly related to the performance of TQM ($r = -0.70, p < 0.05$). Internal R&D increases the value of manufacturing companies. Furthermore, new market development is related to technological cooperation in a moderated degree ($r = 0.38, p < 0.05$).

Table 3 Results of regression analyses

<i>Independent variables</i>	<i>Model 1</i>		<i>Model 2</i>	
	<i>b</i>	<i>t</i>	<i>b</i>	<i>t</i>
<i>Controls</i>				
Market capitalisation	0.33	2.21**	0.29	2.01*
New market development	0.12	0.20	0.08	0.14
Annual sales	0.05	0.12	-0.12	-0.23
<i>Direct effects</i>				
M&A intensity			-0.40	-2.51**
Technological cooperation			-0.15	-0.49
Quality problems			-0.61	-3.01**
R^2 (Adjusted)	0.35		0.81	
ΔR^2			0.46	
F	6.21**		12.57***	
Partial F			10.52***	

Note: Two-tailed tested, $n = 51$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5 Conclusions

The theory articulated in this study suggests that horizontal integration by M&As, and different categories of technology acquisition path (TQM implementation by using internal R&D and technological cooperation by using external R&D) constitute three important sources for firms' technological development. Taking this as a starting point, this study generated a series of hypotheses that predicted these sources' influences on firms' innovation performance. Considering patent as a crucial index to measure firms' internal technological innovation, these hypotheses were tested on data from the global automotive industry from 2000 to 2005. The results provide support for the views that M&As enhance little innovativeness, and TQM implementation enhances internal innovation. Technological cooperation, however, was not associated significantly with firms' internal innovation.

In the auto industry, global M&As have occurred because automakers realise that they need to have a vigorous presence in every market of the world if they are to achieve the full benefits from globalisation. Automakers have been merging speedily to achieve economies of scale and scope. On the one hand, global automotive companies can enjoy the low costs of production and new market entrance from having global supply chains and channels. On the other hand, they expected to obtain valuable R&D and car-making skills from M&As. In this study, however, M&As cannot improve firms' internal technological development. There are three possible explanations. Firstly, M&As require extensive preparation, negotiations, analyses and evaluations. Once an M&A is completed, the integration of acquired assets becomes crucial. During this process, the attention of top managers may be diverted from internal activities such as developing new products and long-term innovative technologies (Hitt et al., 1990). On the contrary, top managers pay much attention to achieve short-term financial performance. Another

reason is the increased use of debt. Doing M&As increases debt cost and diverts investments from internal R&D development. Debt holders usually set rules to forbid highly risky R&D projects. This will reduce the speed of innovation in intensive M&A industries (Morgan, 2001). The third possible reason is the increased organisational size. Intensive M&As is sometimes similar to large formal hierarchies, slow speed of functional communication, and infeasible organisational activities. These organisational features are all supposed to harm the generation of organisational creativity and inter firm innovation (Amabile et al., 1996; Woodman et al., 1993). It is not surprising that M&As could not help advance new technology and new products since many studies have reported the high possibility of failure in actual takeovers (Brush, 1996; Damanpour and Gopalakrishnan, 2001; Hamel, 1991). In this study, we can also see that high M&A intensity might reduce corporate market capitalisation to a certain extent. Horizontal integration is not necessary to create benefits, although value-adding is supposed to be one of its advantages (Hill et al., 2004; Pothukuchi et al., 2002). Empirical investigations also showed that more than 31% M&As cases suffered decreased corporate value, while only 30% of them increased in value. The reasons of takeover failure include extremely conflicting organisational cultures, hostile acquisition, loss of professionals in the firms which are taken-over, underestimation of the associated costs and overestimation of the benefits of integration (Stevenson, 2002; Tushman and Nelson, 1990).

Research on process management and strategy management shows that TQM is expected to enhance cross-function connection. This work also indicates that TQM, which emphasises on the ability to produce products that satisfy consumer demands, and on the increases of product performance, features, reliability and conformance, will enhance interfirm innovativeness. The concept of continuous improvement is in harmony with the development and adoption of internal innovation within an organisation. Moreover, TQM in the global auto industry should include the management of outside suppliers because more than 70% parts of a typical car are manufactured by first and second tier suppliers of an automaker. Thus, this study highlights the role of TQM implementation that implies to place importance on the collaboration of vertical partnerships.

In this study, however, technological cooperation was not associated significantly with firms' internal innovation. There are three possible reasons. Firstly, R&D transfer across organisations is complicated because divergences in organisational culture, processes and knowledge system may lead to a failure of innovation (Lane and Lubatkin, 1998). Another reason is that partners in technological alliance are usually rivals. To hold back in the alliance is due to the fear of helping competitors. Finally, the high failure rate of alliance (50%) also impedes the effectiveness of technological cooperation.

Firm's decisions to outsource or self-produce have different impacts on the strategic choices of technology acquirement. Implementing technological cooperation with competitors could help establish technical standards and ensure the usage of standardised components to reduce costs. However, this does not seem to facilitate critical organisational technology and patents in the automotive industry. On the contrary, strengthened product quality and continuous improving philosophy could help both patent capability and market capitalisation. As manufacturing processes continuously improve, TQM techniques focus on increasing efficiency by coordinating all departments and employees in the organisation. The TQM philosophy, concentrated on organisational coordination, rationalisation of procedures and duplicating of routines, is a procedure-oriented activity for reducing the number of defective, over-variant

products (Kimberly and Evanisko, 1981; Stevenson, 2002). In the automotive industry, good quality and new products provide corporate niches when making strategic choices.

This study tries to show that M&As and technological cooperation are not a catholicon in firms' technological development processes. Nonetheless, this study only focused on one industry. Therefore, managers must be careful about making any expansive generalisations, especially when discussing service industries. There is a need to explore the industrial characteristics and alternative cooperative strategies. The time period in this paper was six years, approximating the period of product life cycle in the auto industry. Despite such short-term defects on internal technological development, however, M&As and alliance are still expected to succeed in the following decade as these big car groups become world leaders. It may be worthy of further study to investigate follow-up M&As and technological development in the global automotive industry.

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