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Managing Risk and Synergies R&D-Collaborations:

The case of Mobile Commerce*

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Abstract:

Many companies in the cross section of telecommunication and mobile technology engage in R&D collaborations to manage uncertainty, create synergies and learn. While the challenges of managing individual collaborations are well documented, little is known on how to systematically manage several R&D collaborations simultaneously. We use modern portfolio theory as an analogy to show how companies active in mobile telecommunication manage risks and create synergies by simultaneously engaging in several inter-firm collaborations.

Keywords: Portfolio theory, risk, synergy, R&D collaboration, mobile commerce

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1. Introduction

The forces of technological change create new demands and sharpen competition in high-tech business fields such as wireless commerce, in which global competitive battles require firms to adapt to rapidly changing environment. Under high degrees of uncertainty, R&D collaborations often outperform go-it-alone and acquisition-based strategies (Teece, 1992; Hagedoorn, 1993; Doz and Hamel, 1996). However, finding and maintaining the optimal mix of collaborations is not a straightforward matter to managers concerned with mastering new technology, developing capabilities, and marketing innovative high tech products. A recent McKinsey study (2002) concludes from a survey of 500 firms that too often collaborative portfolios grow into a random mix of ventures assembled over the years by various business units; that overall performance measurement and coordination of the collaborative portfolio is lacking; and that alignment between a company's overall competitive strategy and its various collaborative activities is often missing. While the literature on *individual* collaboration is large (e.g. Ireland et al, 2002 for a review), studying the challenges of simultaneous management of multiple collaborations is a neglected issue in both research and managerial practice (e.g. Harbison and Pekar, 1998; de Man and Duysters, 2002).

The key question of this paper is *how to manage portfolios of R&D-collaborations?* To date very limited academic guidance is available to inform decision-making in the management of portfolios of R&D collaboration in general and in particular on how to manage risk and create synergies among several individual R&D collaborations that compose a particular firm's portfolio. In the following, the paper briefly outlines what is meant by portfolio management of collaborative R&D and explores how insights from portfolio analysis can help manage key risks and contribute to the creation of synergies when a set of relationships are managed as a portfolio rather than a set of discrete contracts. A managerial framework is offered introducing risk diversification and portfolio synergies as two key variables portfolio managers of R&D collaborations need to consider. The framework is illustrated through examples from mobile commerce.

2. Managing portfolios of R&D collaborations

Just as financial portfolio management helps hedge against market unknowns, collaborative portfolios help understanding the risks and opportunities of several inter-firm collaborations pursued simultaneously. Numerous terms and concepts from the financial portfolio analysis literature have parallel applications in the context of managing collaborative portfolios. Modern

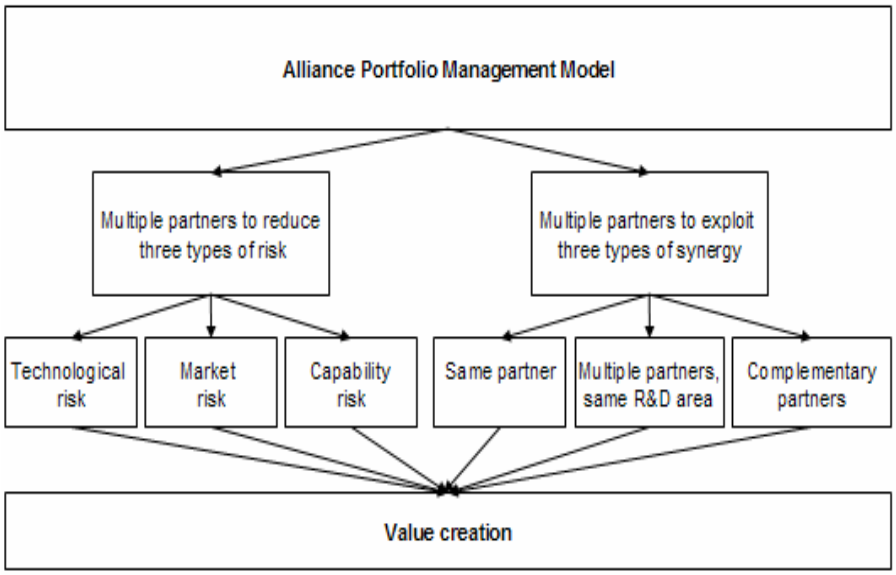
Portfolio Theory (MPT) founder Harry M. Markowitz (1952) formulated the portfolio problem as a choice of the mean and the variance of a portfolio of assets that exploits the effects of asset return correlation to diversify portfolio risks (Elton and Gruber, 1997). Markowitz's student William F. Sharpe (1963, 1970) encouraged application of MPT outside the original domain of financial asset management, suggesting that portfolio theory is concerned with decisions involving outcomes that cannot be predicted with complete certainty, that uncertainty need to be acknowledged, and that the interrelationship among outcomes is dealt with explicitly. We use analogue reasoning to show how MPT can inform the systematic management of a portfolio of R&D collaborations.

Analogue reasoning demands careful consideration of whether MPT insights meaningfully translate into the context of collaborative portfolios. For example, R&D collaborations differ from shares and bonds as an asset type. A financial investor is rarely in the position to impact the performance of individual bonds and shares, but seeks to optimise portfolio performance by combining financial assets, as well as through timing of their purchase and sales (Lubatkin and Chatterjee, 1994). Likewise, managers of R&D-collaborations may optimise the return/risk relation of their relational portfolio through combining several alliance contracts, as well as clever timing of new collaboration or the termination of unproductive ones. In addition, however, companies can actively influence performance by searching for synergies between individual collaboration (Kale, Dyer and Singh, 2001; Anand and Khanna, 2000). Finally, whereas monetary returns on financial investments are easily appropriated (because rights to financial assets and their cash flows are well defined), capturing returns on inter-firm collaboration is more difficult, for example because defining property rights to jointly developed capabilities as return to collaborative efforts is inherently complicated (Hamel, 1991; Inkpen and Beamish, 1997).

Despite these differences, there are strong similarities making analogy reasoning suitable. A financial portfolio is defined as a set of assets; a portfolio of collaboration is a collection of interfirm relationships. A financial portfolio is diversified in the risk of individual securities; a collaborative R&D portfolio seeks to diversify risks inherent in relationships. In line with MPT's risk diversification logic, the "reduction, minimizing and sharing of uncertainty in R&D" has been identified as a leading motive for high-tech firms to engage in R&D collaborations (Hagedoorn, 1993:373; Mowery, Oxley and Silverman, 1996). Finally, in both types of portfolios, managers seek to utilize interdependencies between outcomes. Outcome correlations in financial portfolios help for example reduce return variability, while outcome

correlations between R&D relations lead to risk reduction and synergy creation as illustrated below.

The managerial objective pursued by our framework suggested below is to show how to improve the risk/return profile of a firm's collaborative R&D portfolio. The next sections introduces our framework by discussing and illustrating its key dimensions.



2.1 Managing risk: Identify and diversity collaborative R&D risks

If a company would confine itself to a single R&D collaboration it would suffer the full drawback if this relation fails to meet expectations. Portfolios of R&D collaboration diversify away part of the R&D risks that stem from 'putting all eggs in one basket.' Of particular relevance are two types of risks that typically characterize R&D collaboration: (1) technology risks, and (2) market risks. These are defined in the following and illustrated through examples from the world of mobile commerce. Subsequently we show how companies deal with such risk by engaging in multiple R&D collaborations.

Technology and capability risks. In high-tech industries, technology standard races among competing technologies imply technology risks at the firm level (Anderson and Tushman, 2001). Discontinuous technological change initiates an era of ferment during which the new technology competes against both old technologies and multiple emerging versions of the new technology. A company might not be sure about the value creating potential of a

partner's technology as compared to own and parallel technology developments by others. Thus two central questions are: What technology will win? Will we have access to capabilities required to master the winning technology? Consequently, positioning in relevant technological trajectories becomes critical for firms to reduce their exposure to technology obsolescence risks and engaging in multiple R&D collaborations is a means to diversity technology risks by supporting access to required capabilities. An illustrative example is found in the market for operating systems for mobile handsets. In 1998 Motorola joined forces with Nokia, Ericsson (today Sony-Ericsson), and Psion in a joint venture named Symbian to develop and support an open operating system for current and next-generation mobile information and communication services (Samsung and Siemens have later joined). The operating system is a central component of mobile devises and being the leading producer in this market allows companies to be influential in standard interface development between computing and telephony. As Ancarani and Shankar (2003) suggest the Symbian OS may drive standards for the interoperation of data-enabled mobile phones with mobile networks, content applications, and services. Hence, allying to develop and support a specific OS can decrease technology risks. Symbian, however, is currently fighting a technology standard war against Microsoft that has launched its own mobile operating system and also seeks and has achieved strategic support from leading industry players such as network operator Orange and, notably, handset manufacturer Motorola. In this way Motorola is placing its bets on two horses. While Motorola sold its shares in Symbian in 2003, the company did not abandon Symbian's technology nor the partnerships to companies advocating the standard. Rather it hedges its bets and has several Symbian and Microsoft-based products in the pipeline. Hereby, Motorola reduces its technology risk, for instance in terms of lock-in, by betting on both competing technologies and their promoting companies.

Market risks. In highly turbulent market environments, uncertainties prevail on how to commercially exploit technology even if its superior performance can be ascertained. Such uncertainties concern what customers will ultimately demand and pay for. In mobile commerce, market risks for new data services are substantial. High uncertainty prevails about which future killer applications will drive revenue generation, which content types will attract customers, and customers' willingness to pay. NTT DoCoMo CEO Tachikawa recently noted that the lessons learned from the launch of the infamous i-mode wireless Internet service in 1999 renders up-front predictions of future killer applications illusive (Economist, 18.07.2002). In response, NTT DoCoMo emphasizes resources and time for experimentation "because our customers will decide [the commercial success of new applications]" and hence, "experimentation is key"

(Boston Consulting Group, 2002). NTT DoCoMo's experimentation strategy is enacted through its attempts at co-operative service development with several leading software vendors: In April 2001 NTT DoCoMo teamed up with German software leader SAP to develop systems and corporate services, as well as explore possibilities to jointly market such services in the firm's existing markets. By November 2001, a similar alliance was forged with IBM's Lotus Software unit to jointly develop and globally market wireless multimedia business solutions. Following announcements in February 2002 that NTT DoCoMo was seeking additional system integrator partners to "help harness the full capabilities of its high-speed 3G services" (Reuters, 08.02.2002), and consequently, an additional R&D cooperation with the software maker Oracle was forged.

The above examples suggest that through engaging in multiple R&D collaborations portfolio risks can be reduced through diversification in two major ways. First, if a company makes a split in its R&D budget between two collaborations it reduces risk exposure in its portfolio of collaboration. If one relationship fails, the other might still work. Secondly, risk is reduced where negative movements in some relationships are partially cancelled out by positive ones in others. Despite its merits, managing risks in collaborative portfolios is only a first step. By considering synergies as a crucial return dimension, collaborative portfolios can be constructed that exhibit superior risk and returns to any single R&D collaboration.

2.2 Managing returns: Identify and exploit portfolio synergies

Managers of collaborative R&D portfolios need to identify and exploit synergies among their R&D collaboration, the sources of which include (1) partner-specific capabilities - synergies stemming from engaging in multiple alliances with the same partner; and (2) combinative capabilities - synergies obtained through engaging in several collaborations within the same area of R&D.

Partner-specific synergies rest on repeated interaction. Synergies in R&D collaborations may stem from repeated interaction between two partnering firms. Often synergies result in the form of new collaborative business ideas and opportunities generated by success in previous collaboration. Examples of sources of partner-specific synergies include repeated ties with the same partner and leveraging inter-firm routines (Dyer and Singh, 1998). Over time, partnering experience leads to successful conflict management supporting continued collaboration despite high uncertainties signifying R&D activities, and the accumulation of

interfirm trust and partner-specific absorptive capacity (Ring and Van de Ven, 1994; Doz, 1996; Mowery, Oxley and Silverman, 1996). HP is well-recognized for its alliance capability. The firm has a dedicated alliance function that manages the firm's portfolio of external relations to alliance partners. In 2003 HP and Disney entered a 10 year strategic alliance to co-develop new technologies with a focus on content delivery (including mobile content). HP had previously worked extensively with Disney and had among other things, overseen Disney's e-mail consolidation project, merging 190 locations in 40 countries with 17 systems into one central system. It has also provided the company with more than 70.000 desktops, 10.000 servers and - in Disney's Orlando resorts alone – 13.000 LaserJet printers. Likewise, before becoming part of HP, Compaq was heavily involved in Disney. Compaq was the technology provider and sponsor of a Disneyland exhibit in 1998 called Innoventions. In 2000, Compaq and Walt Disney Internet Group announced a three-year agreement naming Compaq as the preferred provider for the Mouse's online presence. As Bob Iger of Disney explains, valuable pre-existing relationships with both Compaq and HP helped clear the way for the deal (Computer Dealer News, 24.10.2003). One of the reasons is that learning in and about inter-firm routines (Hamel, 1991; Makhija and Ganesh, 1997, Dyer and Singh, 1998) present a source of synergies, as established patterns of interaction may be leveraged across multiple R&D projects. Members of partnering firms have long-established work groups that collaborate on product roadmaps, technology standards and industry trends. "The advantage gained by leveraging all of those established working relationships is huge…" explains an alliance manager of HP, "…we knew we could deliver our systems, and it would work together with all the other parts. Our people have worked with the partner before, which means it all comes together so much more quickly." As the case illustrates, existing interfirm product development routines can form the basis for the synergetic advantages in a repeated R&D collaboration with the same partner.

Combinative synergies rest on multiple partnerships. Combinative synergies are reaped across R&D alliances with different partners performing similar and/or complementary activities. Nokia has taken a first mover position in merging the handheld game console and mobile telephone markets with the development of its N-gage gaming phone. While Nokia linked up with several game developers, the lack of market knowledge within gaming resulted in an unattractive first model of the phone that has so far been a commercial failure. Among the reasons is a lack of market penetration in Korea and Japan, both markets account for over 50% of the total gaming market and require the mastery of mobile computing standards that N-gage does not support. Competing against gaming giants such as Sony, Nintendo, and Sega, are there reasons to expect that Nokia should have engaged in multiple partnerships with for example telecom providers in these markets to increase the likelihood of success? DoCoMo and Sony

Computer Entertainment Inc. have recently pooled complementary R&D resources to jointly develop and market services for a new i-mode/Playstation entertainment network. The companies formed a joint venture in 2003 to develop new services based on mobile phones equipped with Sony's IC Card technology. Prior R&D collaborations preceded this alliance. NTT DoCoMo simultaneously formed wireless application R&D collaboration with the two global leaders, namely Sony Playstation and SEGA, to develop mobile gaming applications for the consumer segment. Gaming was seen as a key revenue driver so that in August 2000 NTT DoCoMo and Sony announced plans to link their blockbuster products: (1) DoCoMo's i-mode Internet service enabled with Java for rich graphics and (2) Sony's PlayStation game console to enable users to play the same game at home and outside (Reuters, 29.01.2001). Almost simultaneously, NTT DoCoMo announced another R&D collaboration with Japanese SEGA, a key competitor of Sony, which aims to fuse i-mode with SEGA's NAOMI video arcade machines installed in arcade centres nationwide in Japan.

By engaging in several R&D collaborations simultaneously, combinative capabilities develop allowing a company to leverage learning from one alliance to another. The sharing and combination of strategic knowledge and technologies across R&D collaborations leads to synergies that are hard to obtain in a single R&D relationship. In their seminal study of the Toyota knowledge sharing network, moreover, Dyer and Nobeoka (2000) found ample evidence of valuable sharing of product and process technologies across similar suppliers. A parallel can be found in mobile telecommunication where the Dutch network operator KPN Mobile have launched i-mode mobile multimedia services in the Netherlands, Germany, and Belgium through a strategic partnership with Japanese NTT DoCoMo. Through the partnerships DoCoMo has transferred the core constructs of its business model to KPN. Also the partnerships established by DoCoMo with leading content providers such as Disney, CNN and Reuters has been transferred to Europe. Whereas the i-mode services in Europe experienced a slow take-off period the adoption has now accelerated and in early 2004 KPN registered its first million i-mode subscribers. Simultaneously, DoCoMo has engaged in a similar alliance with AT&T Wireless in the US to facilitate the rapid establishment and development of i-mode technology and know-how to boost mobile multimedia services in the U.S. market as well.

The above examples of partner specific and combinative synergies suggest that through engaging in multiple R&D collaborations, portfolio synergies may be obtained. First, a company can gain synergies through repeated collaborations with the same partner. By doing so, interfirm routines and prior learning can be leveraged. Secondly, by engaging in several similar or complementary relations (Richardson, 1972), the firm develops crucial absorptive capacity

(Cohen and Levinthal, 1990) bringing the focal company in a learning advantage in a particular R&D area.

5. Managing R&D portfolios

So how do you go about constructing a relational portfolio to reap synergies and keep R&D risks under control? There are several guidelines that managers of a relational portfolio may follow, including the following:

Risky relations vs. risky portfolios. It is important to think about risk in a portfolio context, not an individual relationship context. Small percentage allocations to riskier relationships like emerging technologies can actually reduce the risk of the overall portfolio because they don't operate on the same technology cycles. By implication, small amount investments might suffice to diversity risks.

Risk profiling vs. return is crucial. Risk profiling in relational portfolios is a tricky business that depends on the time horizon (when will we need to decide to initiate, expand, scale down, or terminate the relation? When will we be able to realize returns?); and risk tolerance (How is our performance and slack level? How long can we wait until returns to a relationship materialize?). By implication, when engaging in additional R&D relations, determine the time frame of the engagement. Next decide how much downside risk over that time frame you can accept. Always remember, that the consequence of risk is more important than the probability of risk. Risk should be assessed in terms of how much damage it would do to your ability to allocate resources to R&D projects, the results of which you need at some time in the future.

Active monitoring and rebalancing of relational portfolios. Rebalancing consists of regularly adjusting the portfolio in response to changing risk-synergy relations. By implication, if you don't rebalance, periods of high speed adoption in some technology development projects and/or low speed for others will mess up desired risk-synergy profiles. If technology adoption trajectories reverse then such a portfolio might experience greater losses or be less exposed to the recovery in underperforming relations.

4. Conclusion

We have provided several examples of firms utilizing the portfolio rationale for mitigating specific risks or exploiting specific synergies. A managerial framework is proposed to this end based on analogue reasoning from portfolio theory and empirical evidence from the mobile telecommunication sector. A portfolio of R&D collaborations is often more than the sum of its parts. Because not all relationships perform the same way, a portfolio of many relationships usually offers a superior overall relationship between risk and return to any single collaboration.

In particular, it is argued that two managerial levers are useful to complement the parallel individual management of the focal firm's R&D collaborations. Multiple collaborations are a means to diversify and thereby reduce a portfolio's collaborative risks in terms of three critical risk classes associated with R&D: market risks, technology risks, and R&D/capability risks. Up to a certain point, small percentage allocations of R&D funds to additional riskier relationships (as compared to current relations) to explore emerging technology can actually reduce the risk of the overall portfolio because they don't operate on the same technology cycle as currently developed technology. Small investments in such additional R&D collaborations can have a great impact on the risk profile of an existing collaborative portfolio. A collaborative portfolio's total returns can be increased by exploring synergies among collaboration. Synergies will be the greater, the less diverse and the more similar R&D collaborations are. While R&D collaborations with greater technology and market risk may add more learning possibilities, they compromise synergy as well. Thus, crucially by simultaneously considering synergies and risk of multiple partnering, the focal firm exploits interdependencies (both positive and negative) among collaborations.

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