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Entrepreneurship, Emerging Technologies, Emerging Markets

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Academics and practitioners alike have long understood the benefits, if not the risks, of both emerging markets and emerging technologies. Yet it is only recently that foresighted firms have embraced emerging technologies and emerging markets through entrepreneurial activity. Emerging technologies and emerging markets present both unique challenges and tremendous opportunities for those firms and individuals who focus their search for competitive advantage on them. Here, we provide examples of effective commercial pathways for both intra- and entrepreneurial ventures embracing these phenomena. First, we describe how one intrapreneurial large firm is investigating emerging markets such as India and China (emerging economies) with emerging technologies to create a worldwide business solution power. Then the investigation of an emerging technology is provided, that of nanotechnology, by a small entrepreneurial firm utilizing emerging market skill sets to define and enable worldwide business solutions. Interestingly, both of the respective commercialization strategies are based on competency theory

albeit, used differently. Finally, we discuss the ability of large and small firm competency-based strategies to wrest value from the opportunities inherent in emerging markets and technologies.

KEYWORDS: emerging markets; emerging technologies; entrepreneurship; established markets; nanotechnology; opportunity recognition

Introduction

Firms seeking advantage by embracing emerging markets and emerging technologies through entrepreneurial activity reflect much current academic thought and corporate practice. Large and small firms today are embracing new emerging markets with technology-based offerings as suggested in Friedman's (2005) *The World is Flat*. Similarly, these same firms' strategies are in line with Schumpeter's (1934/1983) view of commercializing emerging technologies as a pathway for wealth redistribution. Today, technology-based start-up firms (Schumpeter, 1934/1983) and corporate entrepreneurship (intrapreneurship) (Shane and Venkataraman, 2000) both embrace emerging markets and emerging technologies as the core of their competitive strategies. Entrepreneurial professionals in large and small firms are recognizing the potential of such opportunities. In fact, Kirzner (1973) has long recognized this as a defining characteristic of the entrepreneur.

However, most entrepreneurial scholarly effort has focused on opportunity recognition, basing the interpretation of opportunity recognition on some sort of market gap effect (Kirchhoff and Walsh, 2000). Here we show that at least one element of the opportunity recognition paradigm is driven by technology, especially by emerging and often disruptive technology acting as the source of entrepreneurial opportunity. Disruptive technologies are those that form a potential production base for industry standard products that render useless the industry standard technological competencies, or initiate 'new to the world' industrial offerings (Walsh et al., 2002). Yet, the very nature of disruptive technologies causes large firms to investigate them but not to embrace them as a cornerstone of competitive advantage in the industry where they are dominant (Kirchhoff and Walsh, 2003). Small entrepreneurial firms do not carry the current industry infrastructure and associated corporate strategic initiatives so often have to beat large dominant firms to the market with product offerings based on disruptive technologies.

Opportunity recognition is, however, a necessary but not sufficient condition for success. Many strategists in firms recognize opportunity but far fewer recognize the pathways to capitalize on this knowledge. We highlight the use of emerging markets and emerging technologies by firms seeking successful commercialization opportunities. We show that large firms can take entrepreneurial action (Sarason et al., 2006), which is consistent with Schumpeterian entrepreneurship, by creating new firms in an emerging economy and taking equity positions within them (Schumpeter, 1934/1983). These firms are not large firm spin-outs but rather, greenfield start-ups that take advantage (in our example) of IBM resources. We also illustrate a pathway driven by an entrepreneurial firm embracing disruptive technologies and placing critical assets in emerging markets (Friedman, 2005). In our explanation we use the example of Zyvex as an illustration. Through a review

of both scholarship and practice we provide entrepreneurs with a description of some pathways currently being followed. We hope this may enable entrepreneurs to capitalize on their recognition of emerging technology and emerging market opportunities.

Literature Review

In order for firms to rationally embrace the value in emerging opportunities they must first convince themselves that they understand the nature of these differing opportunities. Only then can a firm investigate its ability to address them in uniquely valuable ways (Walsh et al., 2002). In Figure 1 we provide a modified version of Ansoff's technology market matrix (Ansoff, 1965) to illustrate just how very far afield from established current business interests are the opportunities that leverage emerging markets and emerging technologies. The uncertainty inherent in emerging markets resides in unfamiliar business and political environments that must be faced as well as differing buyer behavior in basic elements, such as preferred market channels. The opportunity, however, often outweighs this risk for either emerging markets and/or emerging technology commercialization. Often emerging markets were historically bounded in some manner (technology, economics, and government policy) and as a result when 'opened' exhibited a rate and pace of product adoption that was radically different from that of established markets (Walsh et al., 1999). Often these emerging markets act as complete lead-user segments (Von Hippel, 1986). Further, since these emerging markets do not have legacy infrastructure, firms can exploit a leapfrogging effort, leveraging newer technologies to develop new business models.

Similarly, emerging technologies can create products that satisfy unmet needs (Abernathy and Utterback, 1988; Kondratief, 1978; Mansfield, 1968) and therefore, lead to opportunity. These, often disruptive, technologies provide firms with great risk in terms of timely acceptance by the market, functionality of the resultant product and in many other areas (Abernathy and Utterback, 1975; Foster, 1986). Emergent technologies-focused firms often seek to disrupt, or displace, current product technology paradigms rendering past competence useless and causing even their inclusion in industrial production to be fraught with hurdles.

Here, we draw upon Friedman's 'Flat World' concepts (Friedman, 2005), competency-based theory (Prahalad and Hamel, 1990) and disruptive technology practice (Freeman, 1982; Kondratieff, 1978; Mansfield, 1968) to provide the basis for pathways that assist firms in the emerging opportunity capture process. Friedman discusses leveraging highly skilled, low cost labor from emerging markets for worldwide problem solution. Here we describe differing pathways that utilize emerging markets in tandem with emerging technologies to provide pathways that create new enterprise models by taking advantage of the entrepreneur's recognition of emerging opportunities. These factors include sourcing capabilities, wherever they are found, and the natural occurrence of simultaneous demand and supply variations inherent in emerging markets. Further emerging solutions, derived from areas such as the emerging technology base of nanotechnology, suggest differing business designs and the difficult task of finding early adopters (Lindblom, 1959; Von Hippel, 1986).

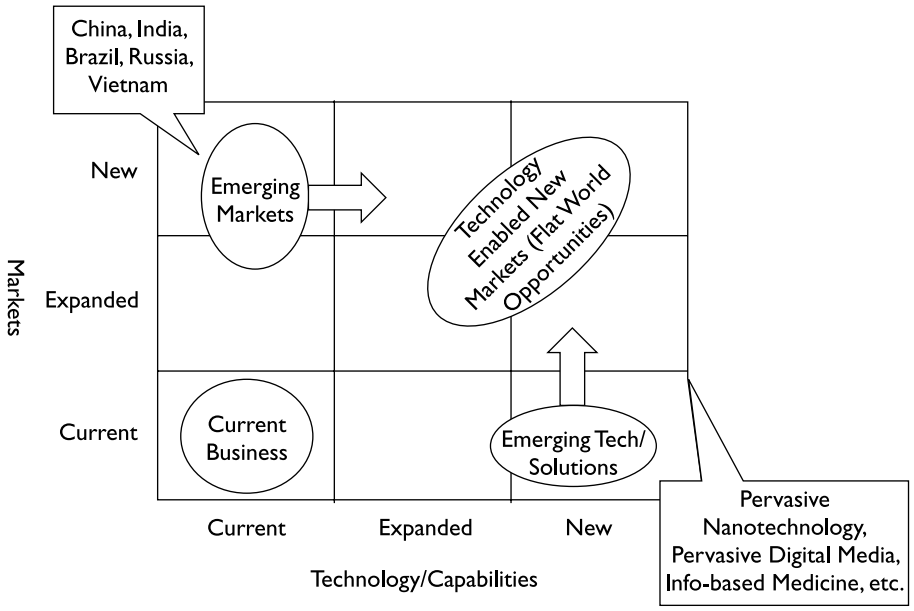

Figure 1. Technology Market Positioning Matrix Delineating Differences

Discussion

Large firms, such as IBM are investing heavily in emerging markets such as India and China. They are engaging in entrepreneurial activity by creating new firms in which they have an equity ownership position (Sarason et al., 2006). These new firms are formed on the basis of disruptive technologies (Smith and Sharif, 2007). Small, emerging technology-based firms, for example the nanotechnology-based Zyvex, are also investigating these regions. Indeed, India is defined as a 'Big Emerging Market' by the World Bank (Walsh et al., 1999). Currently, India is a large market (it is ranked as the fourth largest economy in the world); it is growing extremely rapidly and is poised to become the world's third largest economy within a few years. The appearance of large emerging markets, such as India and China is coming at a time when entrepreneurship has made the transition from a word unspoken in corporate boardrooms to being one of the most 'hyped' phrases to describe corporate professional acumen (Cordero et al., 2005).

Many firms, large and small, are struggling to find pathways to embrace this emerging market opportunity. IBM has taken advantage of the entrepreneurial approach and chosen India, due to its emerging market status in a transition economy (Leskovar-Spacapan and Bastic, 2007) and excellent IBM engineering talent (Menzel et al., 2007; Okudan and Zappe, 2006), to create new spin off firms (Kroll and Liefner, 2007). They are interested in creating highly networked entrepreneurial teams in India (Neergaard, 2005). Similarly many firms are seeking to embrace emerging technology opportunities such as those found in nanotechnology. Zyvex is investigating big emerging markets searching primarily for

the skill base required to create its envisioned nanotechnology revolution, but also paying attention to potential emerging markets in those countries. They are especially interested in utilizing university knowledge (Rasmussen et al., 2006; Rasmussen and Sørheim, 2006) and have reviewed how it has been utilized in transition economies (Marques et al., 2006). Further, they were impressed by India's policy on emerging technology-based entrepreneurial activity (Oakey and Mukhtar, 1999).

Nanotechnology is an emerging technology (Walsh et al., 2005). Here we define emerging technologies as those that hold the promise of creating a new economic engine and are trans-industrial (Linton and Walsh, 2004). Nanotechnologies are technologically multidisciplinary as well as cross-industrially useful, creating greater opportunities, yet also representing greater risk in terms of loss of focus.

The Processes

One common hurdle that firms encounter when embracing either emerging markets or emerging technologies is the hyperbole centered on these phenomena (Elders et al., 2003). Many firms rush to embrace new opportunities with an activity reminiscent of that found in the California 'Gold Rush'. Firms acting like forty-niners rush, without strategic analysis, to have a 'Play' in big emerging markets like India or China. Many firms seemingly know that they should be in emerging markets, or emerging technologies, but they simply do not know how to get there. Here we provide the 'How' of firm entry pathways so often ignored in entrepreneurial and management literature.

Here we address this 'How to?' question by providing two pathways that take much more considered approaches to strategically seeking competitive advantage. Both firm pathways base their strategy on competency theory (Prahalad and Hamel, 1990). The first pathway we discuss is that of Zyvex. We will describe Zyvex's embrace of nanotechnology through a bootstrapping approach described as 'Nanotechnology without the Hype'. The second pathway is that utilized by IBM to explore emerging markets. It is a technique developed at IBM to embrace the many facets of the Indian marketplace through a combination of emerging technology competencies and deep understand-ing of the demands and assets resident in new emerging markets.

The Zyvex Process

The Zyvex emergent technology commercialization process has been named 'Nanotechnology without the Hype'. In brief, the company has a long-term vision of where it wants to go, supported by a strategy to fund that long-term development by creating product and development revenue streams driving towards that goal. This strategy has resulted in faster market success than most peer nanotechnology firms achieve. Many technology-based firms seek competitive advantage by building a portfolio of patents without regard for infrastructure development, hoping for a 'Home Run'. Most have not met with the success that they envisioned. A patent-licensing strategy can take a long time to unfold and is dependent on external market development that the company may not be able to influence. Zyvex's strategy develops infrastructure competency bundles as well, but seeks to create new value

propositions centered on them to solve important worldwide solutions as they focus on their 'endgame'. In so doing they have explored emerging markets around the world for skill sets that enable commercial solutions important to both established and emerging markets.

The Zyvex process has created revenues, by commercializing its emerging technology and developing distinctive competency bundles, while laying a foundation for the ultimate product aim of atomically precise manufacturing. Due to the current state of nanotechnology infrastructure, Zyvex must develop its own tools and manufacturing infrastructure (Walsh and Linton, 2000). The development of this infrastructure also leads to competency bundles from which Zyvex seek to garner value. Zyvex decided to solve current and potential customer problems through the exploitation of these competency bundles.

This process tactically applies sales engineering to emergent technology firm value development. The intermediate result for Zyvex is the creation of value for their own and their partners' products. Finally, this provides Zyvex with a commercially proven technology pathway that underpins and funds their quest for an atomically precise manufacturing capability.

Zyvex is not only interested in creating jobs and wealth (Birch, 1987). It also intends to make a difference in the world by providing the benefits derived from nanotechnology and the emerging disruptive technology base. This strategy is juxtaposed to the 'Grand Slam' vision of many traditional venture capital institutions. Rather, Zyvex focuses on a sustainable firm model developed using a competence timeline to develop atomically precise manufacturing, then utilizing market development tactics to uniquely satisfy customer needs.

How did this happen? Zyvex was started with a grand vision: developing a system capable of programmably manipulating molecules to build 3D structures with atomic precision that would revolutionize manufacturing. With the invention of Scanned Probe Microscopes in the late 1980s, the positional accuracy to undertake such manufacturing exists, but there are huge technical challenges involved in reducing the concept to practice. Even though the future potential of nanotechnology seems unlimited, finding a corporate focus that could be tactically empowered is difficult. Zyvex's 'start from zero' strategy was to superficially explore several potential approaches, while at the same time, remaining alert for commercialization possibilities in the tools or technologies developed. Such a strategy produces a 'highly branched' tree, and it is important to prune such a tree once the promising branches are identified. Such a pruning operation should focus on building competencies that are directed towards the long-term goal, keeping in mind market factors such as profitability, scalability, and reputation. Moving from dozens of potential products and market segments to two, Tools and Materials, Zyvex reorganized to focus on these. Accordingly, lab work halted temporarily on atomically precise manufacturing (APM), and a planning process treating APM as a long-term goal, rather than an active collection of research projects, was initiated. The Tools competency established the skills in micro-assembly – and eventually nanoassembly – required to build the manufacturing systems for APM. This allows Zyvex to sell enabling technology for the entire developing industry while remaining several years ahead. The Materials competency leads to one of the most important early markets for Atomically Precise

products – advanced materials. Zyvex thus has two options on success; key enabling tools, and huge industrial markets.

The pathway of developing focused competencies in an emergent disruptive (Christensen, 1993, 1997; Christensen and Raynor, 2003) technology arena requires focus, alertness for technical and technology commercialization talent, and a corporate partnering strategy. The strategy and tactics adopted required transforming Zyvex from a pure research organization to one that utilizes a 'probe and learn' strategy (Lynn et al., 1996). The strategists developed and utilized the required competencies through sweat equity, founder equity, and judicious partnering.

The selection criteria Zyvex utilizes to choose partners includes matching the vision and strategy objectives of both firms. Zyvex thoroughly reviews their partnership opportunities and rejects most on the grounds of not being able to leverage each company's strengths or strategic alignment. Yet, the organizations and firms they partner with, such as Arkema, Aldila, and the Micro and Nano Technology Commercialization Education Foundation (MANCEF), bring and receive exceptional value. Zyvex also had to learn to say 'No'. 'No' internally in order to *develop* focus, and 'No' to potential partners in order to *maintain* the appropriate focus.

Zyvex's resultant strategy of not only working for the 'Grand Slam' of APM, but simultaneously focusing on the singles, doubles and triples in developing markets and focusing on the value inherent in their emerging competencies, is creating exceptional value. These Zyvex developed products have appeared sequentially and are embraced by emerging and established markets. Zyvex initially produced nanomanipulators for researchers, which quickly led to nano probing systems for the integrated circuit industry, and follow-on products aimed at that industry. Tools can provide a quick path to market, but ultimately this business has a market size limited by the need for skilled tool users. Nanomaterials products were launched simultaneously, and while ultimately leading to a much larger market, materials have a much slower adoption cycle due to the need for more product testing and performance validation. Zyvex was able to invest Tools profits into Materials development, which today has a higher growth rate and is nearing breakout. All of the competencies that underpin these core products are required by the firm to pursue their corporate vision and focus of APM. Zyvex's market development tactics have enabled their competency development to become profit and market generation centers for the firm rather than cost centers that often plague high-technology development. The result is that Zyvex is one of the very few true nanotechnology firms that actually has sales and strategically aligned partners.

The IBM Process

IBM in India: Capitalizing of Emerging Markets through Entrepreneurial Action

There are several different types of market development activities available to a firm investigating an emerging market. They are, in effect, stimulating new industries from emerging technologies (Hung and Chu, 2006) in emerging markets. IBM investigates

what triggers change and innovation (Montalvo, 2006) on almost a daily basis and this has provided them with a baseline for strategic modelling.

First, there is the classic existing product-new market or the usual emerging market problem. Here, a firm has a product and wishes to extend it to this new market. This is largely a marketing/distribution problem and is the opportunity that IBM hardware business pursues in India. Yet, a more entrepreneurial option available to IBM India is new business formation.

Foresighted large firms seek to proactively construct new opportunities to create new forms of value and share in an emerging market. IBM is helping firms develop their business quickly and provide them with a level of expertise and technology drawn from best practices and laboratories around the world. This enables firms to create totally new business models. This option becomes especially attractive when an emerging market's unique economics force a rethink of the firm's current business/economic model. This option offers 'Leapfrog opportunities' for clients in the Indian market to create unique opportunities. IBM does not simply capture the legacy and lessons from a developed market. This approach has resulted in IBM investigating new partnerships and business models, to address new markets in sectors such as telecommunications, banking, healthcare, etc.

IBM India analyse emerging markets in their business development operation, using a series of questions designed to aid understanding of the dynamic nature of the economy. Many of these questions focus on the price-value equation. It has been found, for example, that Indian buyers are relatively sophisticated and have lived in a global context much longer than other emerging market populations. However, this sophistication is not uniform – it varies between larger metropolitan areas such as Delhi or Bangalore and smaller cities with less infrastructure, which are more regional in nature.

This probing process and the resulting information enables IBM in India to undertake successful market entry sequencing decisions, including which markets to pursue and in what order. This information allows them to see global versus regional product rollout decisions and appropriate pricing levels and to make partnering decisions based on, 'is this a strategic IBM offering' or 'is it a way to gain transactional value on a competence?'. The focus is more upon a decision process of gaining skills and resources, not only for the local offering, but also for IBM globally. Finally, the information allows them to tailor marketing and publicity messages both locally and globally.

These questions and decisions underlie the 'Flat World' opportunity decisions that have to be made that strategically and tactically forge the business structure used by IBM to develop these opportunities. Both demand and supply dimensions are explored to identify opportunities that can benefit from global leverage. This requires a deep understanding of the competition (HR, financial models, etc.) which in turn, lead to location and firm typology selection creating an atmosphere to attract talent and provide maximum customer interaction. The results can be remapped onto original matrix Figure 1. The result is Figure 2, a matrix that maps firm capabilities to market opportunity. Here, each cell provides a map that allows the firm to realise a commercial opportunity pathway.

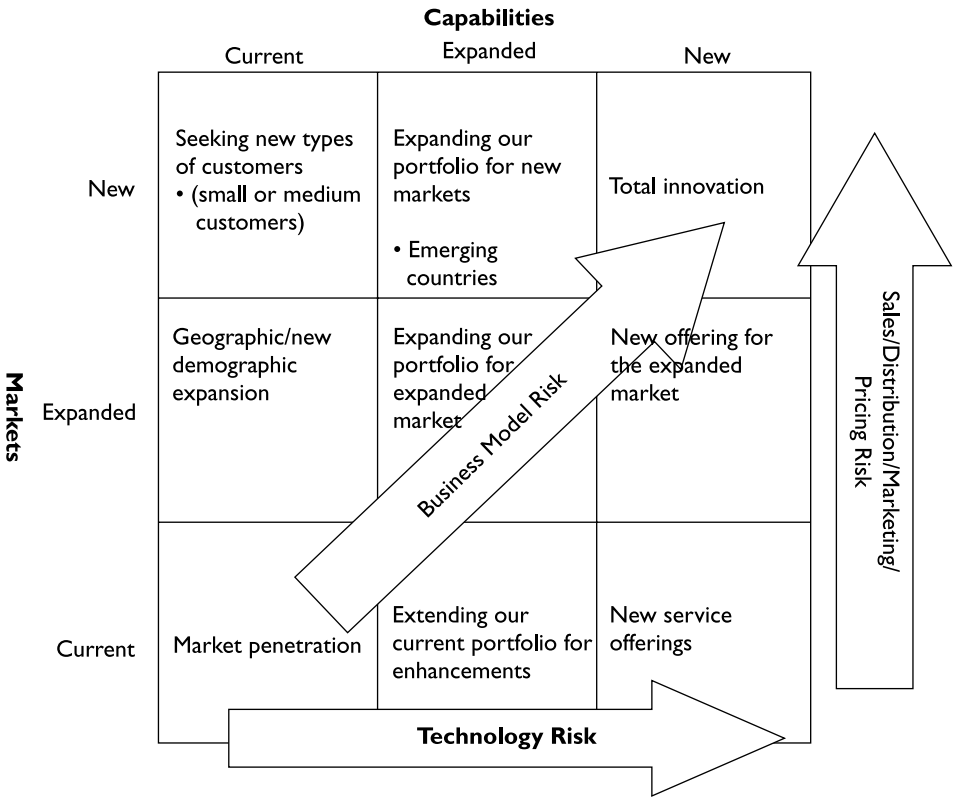

Figure 2. Map of Firm Capability with Market Opportunity

Conclusions

This research note has explored the opportunities and risks presented by emerging markets and emerging technologies. It has been noted that entrepreneurial strategies are adopted by both small, flexible organizations and corporate entities with the ambition of gaining competitive advantage. The need to recognize and develop appropriate competencies to gain leverage in uncertain markets has been clearly identified. Accordingly, drawing upon case study examples, two pathways are identified which entrepreneurial and intrapreneurial organizations can pursue to facilitate the development of required competencies. A pathway is also identified which enables corporate entities seeking to engage with and develop an entrepreneurial stance to achieve this in a more Schumpeterian fashion.

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Entrepreneuriat, technologies émergentes, marchés émergents

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Depuis des lustres, autant les universitaires que les professionnels ont perçu les avantages sinon les risques que présentent à la fois les marchés et les technologies émergentes. Or, ce n'est que récemment que les entreprises, possédant une certaine vision de l'avenir, ont adopté des technologies et des marchés émergents dans le cadre de leurs activités entrepreneuriales. En effet, ces technologies et marchés émergents présentent des défis exceptionnels et des opportunités illimitées aussi bien pour les entreprises que pour les individus qui cherchent à s'assurer une position avantageuse par rapport à la concurrence. Dans cet article, nous offrons quelques exemples des chemins commerciaux rentables, à emprunter dans le cas d'initiatives intra-entrepreneuriales et entrepreneuriales qui intègrent ce phénomène. Nous commençons par décrire de quelle façon une grande société intrapreneuriale effectue des recherches sur les marchés émergents comme l'Inde et la Chine (économies naissantes) avec des technologies émergentes en vue de créer une puissante assise de solutions commerciales de portée mondiale. Puis, nous abordons l'examen d'une technologie émergente – la nanotechnologie – par une petite firme entrepreneuriale qui fait appel à un ensemble d'attributs du marché émergent pour définir et créer des solutions de portée mondiale. Il est intéressant de noter que les deux stratégies de commercialisation se basent respectivement sur la théorie des compétences (Barney, 1991; Prahald et Hamel, 1990) même si elles l'utilisent différemment. Nous terminons en discutons sur l'aptitude qu'ont les stratégies – basée sur les compétences des petites et grosses entreprises - de profiter des opportunités inhérentes aux technologies et marchés émergents.

Mots clés: Marchés émergents; Technologies émergentes; Entrepreneuriat; Marchés établis; Nanotechnologie; Reconnaissance des opportunités

Emprendedurismo, tecnologías incipientes, mercados incipientes

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Hace ya mucho tiempo que tanto los académicos como los profesionales están enterados de los beneficios, si bien no de los riesgos, que comportan las tecnologías y mercados incipientes. Sin embargo, hace poco que las empresas con visión de futuro han adoptado las tecnologías y mercados incipientes por medio de las actividades empresariales. Las tecnologías y mercados incipientes representan verdaderos desafíos y oportunidades ilimitadas para aquellas empresas y emprendedores que buscan una situación de ventaja con respecto a la competencia. Aquí, ofrecemos algunos ejemplos de los caminos del éxito comercial para las actividades tanto empresariales como intraempresariales que abarcan estos fenómenos. Primero describimos cómo una gran firma intraempresarial está investigando los mercados incipientes de la India y China (economías en vías de desarrollo) con tecnologías incipientes para potenciar las soluciones comerciales a nivel mundial. A continuación hacemos una investigación de una tecnología incipiente, la nanotecnología, por parte de una pequeña empresa que emplea un conjunto de atributos de mercado incipiente para definir y crear soluciones comerciales a nivel mundial. Curiosamente, las dos estrategias de comercialización se basan respectivamente en la teoría de la competencia (Barney, 1991; Prahald y Hamel, 1990), aunque se emplean de manera muy diferente. Por último, discutimos la capacidad de las estrategias basadas en la competencia de las pequeñas y medianas empresas para sacar provecho de las oportunidades inherentes a los mercados y tecnologías incipientes.

Palabras clave: Mercados incipientes; tecnologías incipientes; emprendedurismo; mercados establecidos; nanotecnología; reconocimiento de oportunidades.

Unternehmertum, neue Technologien, aufstrebende Länder

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Akademiker und Praktiker erkennen seit langem schon die Vorteile sowie die Risiken der aufstrebenden Länder und neuen Technologien. Doch erst seit kurzem haben vorausschauende Unternehmen neue Technologien und aufstrebende Länder in ihre unternehmerischen

Aktivitäten eingebunden. Neue Technologien und aufstrebende Länder stellen einmalige Herausforderungen und große Chancen für diese Unternehmen und Einzelpersonen dar, die ihren Wettbewerbsvorteil in diesen Ländern suchen. Hier stellen wir einige Beispiele effektiver wirtschaftlicher Wege für unternehmerische und intrapreneurische Vorhaben vor, die diese Phänomene aufgreifen. Zuerst beschreiben wir, wie ein großes, nach dem Konzept des Intrapreneuring geführtes Unternehmen die aufstrebenden Länder wie Indien und China (aufstrebende Märkte) mit neuen Technologien erforscht, um leistungsstarke, weltweite Geschäftslösungen anbieten zu können. Dann zeigen wir die Erforschung einer neuen Technologie, der Nanotechnologie, durch ein kleines Unternehmen, das mit Hilfe seiner Fachkenntnisse über die aufstrebenden Märkte weltweite Geschäftslösungen definiert und ermöglicht. Interessanterweise basieren beide Kommerzialisierungsstrategien auf die Kompetenztheorie (Barney, 1991; Prahald und Hamel, 1990), auch wenn sie sie anders anwenden. Zum Schluss diskutieren wir, ob kompetenzbasierte Strategien von kleinen und großen Unternehmen überhaupt einen Wert aus diesen Chancen, die sich aus den aufstrebenden Ländern und neuen Technologien ergeben, schöpfen können.

Schüsselwörter: Aufstrebende Länder; neue Technologien; Unternehmertum; etablierte Märkte; Nanotechnologie; Wahrnehmung unternehmerischer Gelegenheiten

创业，新兴的技术，新兴的市场

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如果不是新兴市场和新兴技术的风险，学者们和实践者一样对其收益应该已经有了长期的了解。然而直到现在，只有富于远见的企业通过创业活动抓住了新兴的技术和市场。新兴的技术和市场对于那些致力于寻求其竞争优势的企业和个体来说，呈现出独一无二的挑战和极大的机会。在此，我们提供了有关公司内创业和新事业创业抓住这些机会的有效商业途径的案例。首先，我们分析一个大型内创业公司是如何调查象印度和中国(新兴经济)的新兴市场，并运用新的技术创造了一个世界范围的商业解决能力；然后，我们提供了一个关于新兴纳米技术的调查，来看一个小的创业企业如何利用新兴的技

术设备使得世界范围的商业解决途径成为可能；有趣的是，尽管用途迥异，但这两种商业化的战略都是建立在能力理论的基础上的。最后，探讨了基于竞争力战略的大企业和小企业挖掘新兴的市场和技术内在机会价值的能力。
关键词：新兴市场；新兴技术；创业；现有市场；纳米技术；机会识别