

Open Research Online

The Open University's repository of research publications and other research outputs

International migration, knowledge diffusion and innovation capacities in the Indian pharmaceutical industry

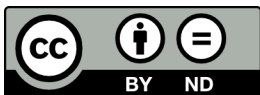
Journal Item

How to cite:

Kale, Dinar (2009). International migration, knowledge diffusion and innovation capacities in the Indian pharmaceutical industry. *New Technology, Work and Employment*, 24(3) pp. 260–276.

For guidance on citations see [FAQs](#).

© 2009 Blackwell Publishing Ltd.



<https://creativecommons.org/licenses/by-nd/4.0/>

Version: Accepted Manuscript

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.1111/j.1468-005X.2009.00233.x>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's [data policy](#) on reuse of materials please consult the policies page.

**International migration, knowledge diffusion and innovation capacities
in Indian pharmaceutical industry**

Dinar Kale
ESRC Innogen Centre,
Faculty of Technology, The Open University

Draft Prepared for
Submission to New Technology Work and Employment

Please address correspondence to D.Kale@open.ac.uk , The Open University

Abstract

Evidence suggests that 'Reverse brain drain' of engineers and scientists trained in the US or Europe can accelerate technological upgrading in knowledge based firms in emerging countries. There are important ways in which communities of returned scientists and engineers can provide the skill and know-how to help local firms shift to innovative activities. However the firm level issues associated with knowledge transfer and creation through returned migration is still poorly understood. Literature focused on knowledge flow shows that the transfer of knowledge through human mobility is not a straightforward process. This paper presents human resource management strategies adopted by firms from developing country in attracting and retaining scientific workforce. It also points out firm level issues involved in knowledge transfer and creation through migration of scientific labour using case studies of innovative Indian pharmaceutical firms.

1. Introduction

With increasing globalisation, firms are entering a dynamic world of international business that is marked by liberalisation of economic policies in large number of emerging economies. In rapidly changing environment knowledge has emerged as a key resource and an ability to learn fast, adapt to new challenge an important capability, termed by Teece et al., (1997) as ‘dynamic capability’. It enables firms to create new technologies and to develop new products and processes in response to a changing economic environment. The challenge is to find new ways of sourcing innovative knowledge lying outside firm boundaries.

In developing countries firms faced more difficulties in accessing innovative knowledge due to political and economic complexities. In last decade communities of scientists and engineers based overseas working in MNC R&D and universities has emerged as one of key source. According to Saxenian, (2002, 2006), immigrant entrepreneurs and their communities provide a significant mechanism for the international diffusion of knowledge and upgrading of local capabilities. For many countries trans-national communities of professionals are a major source of foreign direct investment, market development, technology transfer and more intangible flows of knowledge, new attitudes and cultural influence. Evidence suggests that mobility of foreign educated experts or scientists has played a crucial role in the development of capabilities in South Korean and Taiwanese firms. In these countries, talented immigrants who have studied and worked in the US increasingly reversed the “brain drain”, shifting these countries from a peripheral source of cheap labour to global leadership in IT production. Realising this, emerging countries such as China and India has set up policies to bring back to its overseas scientist and engineers. Thus now in global world, countries and firms are competing to attract and retain scientific talent and knowledge raising questions about nature of national and firm level issues and

socio-economic factors that are affecting the supply and demand for the scientific workforce. Saxenian (2002) argues that government policies and firms' strategies played a key role in "reversing brain drain", showing that immigrant entrepreneurs, and their communities' experience and networks, can accelerate the process of learning about new sources of skill, technology and capability in home countries. However Williams (2006) emphatically points out that there are still major gaps in our understanding of the specific contribution of international migration to knowledge transfer, of the processes involved, and of the conditions that facilitate or constrain this.

It is vital to understand how returnees contribute to creation of innovative knowledge, the obstacles in the effectiveness of firms in acquiring and assimilating returnee's knowledge; and some of the pathways that facilitates organisational learning and knowledge creation by returned scientists or engineers.

The key research question this paper examines is how international migration is creating knowledge base for innovation in Indian pharmaceutical industry. It further analyses what issues are affecting firm level knowledge transfer and HR strategies to overcome these issues.

Section 2 of the paper discusses the literature on management of organisational knowledge creation, organisational learning and innovation management. Section 3 reviews literature on international migration and firm level challenges in knowledge transfer and creation through human mobility .Section 4 provides a brief background to the Indian pharmaceutical industry, noting the main features of the emerging phenomenon of scientists returning to work in Indian pharmaceutical firms. Section 4 details our research methodology while section 5 presents the case studies. Section 6 discusses the major issues affecting effective transfer of knowledge and section 7 covers strategic HR strategies of Indian firms. Section 8 concludes.

2. Managing knowledge within the organisation

The knowledge based view argues that firms exist because they provide the ideal platform for the creation, transfer and application of knowledge (Spender, 1996; Tsoukas, 1996). There is an increasing understanding that knowledge allows the creation of capability and that this determines the ability to do things (Leonard- Barton, 1995) and so the manner of knowing or learning is as important as what should be known (Spender and Grant, 1996). According to Tsoukas and Mylonopoulos (2004) the knowledge based perspective on organisation links two traditionally different domains: the skills that sustain organisational learning and a firm's competitive advantage through its idiosyncratic capabilities.

Central to the emergence of knowledge as a key resource is Michael Polanyi's distinction between tacit and explicit knowledge. Tacit knowledge is subjective and experiential and hard to formalise. Belief, perspective, mental models, ideas and ideals are examples of tacit knowledge. Explicit knowledge is objective, rational knowledge and can be expressed in forms such as data, scientific formulas, specific actions and manuals. This distinction between different types of knowledge is the reason often cited for distinguishing knowledge from other resources.

One of the key contributions towards the emergence of this focus on knowledge and its strategic role are the studies of organisational knowledge creation in Japan by Nonaka and Takeuchi. Building on the distinction between tacit and explicit knowledge proposed by Polanyi (1966) and linking the resource and capability view of the firm with organisational learning literature, Nonaka and Takeuchi (1995) developed the model of the various ways in which organisations create knowledge. Organisational knowledge creation is seen as a capability of the organisation. They postulate that the organisation creates new knowledge through interactions between tacit and explicit knowledge, and

through the dynamic conversion of knowledge between these two dimensions. Through this 'social conversion' process tacit and explicit knowledge expands in terms of both quality and quantity. Knowledge is transferred from individuals to the larger group in a spiralling process. This follows from the proposition that, although tacit knowledge is initially locked up in the heads of the individuals, shared experiences allows individuals to project themselves into each other's thinking processes. This 'SECI' (socialisation, externalisation, combination, and internalisation) spiral represents the dynamic process, starting at the individual level and expanding as it moves through communities of interaction that transcend sectional, departmental, divisional and even organisational boundaries.

Cook and Brown (1999) present a different model for organisational knowledge creation albeit based on a different view of the types of knowledge. They argue that tacit and explicit knowledge are two different forms of knowledge which complement each other but cannot convert into each other. They propose that individuals and groups can each possess explicit knowledge and tacit knowledge, giving four different categories of knowledge. However all four knowledge types can be mutually enabling in the pursuit of purposeful activity or 'active process of knowing'. New knowledge is generated as different knowledge types 'dance' together in course of doing something.

Continuing with different types of knowledge and ways of knowing, Spender (1996: 74) sketches a theory of the firm as a system processing different kinds of knowledge and generating common knowledge. He suggests that knowledge, learning and memory form the interdependent parts of organisational systems which are influenced by particular types of knowledge. Firms comprise four distinct types of knowledge: conscious (explicit knowledge held by the individual), objectified (explicit knowledge held by the organisation), automatic (preconscious individual knowledge) and collective (highly

context dependent knowledge which is manifested in the practice of an organisation). Each implies different learning and memory processes. These different types of knowledge interact dialectically to form an organic system with knowledge both at the level of system and at the level of the individuals it embraces. Lam (2000) argues that there is interactive relationship between different knowledge types and organisational forms. Each organisational form is associated with dominant knowledge type, giving rise different configurations. Each combination of organisational form and knowledge types differ in their ability to mobilise tacit knowledge and hence in their innovative capability. These perspectives all propose that organisations have different types of knowledge and that identifying and examining these will lead to more effective means of generating, sharing and managing knowledge in organisations. However, Tsoukas (1996) characterised such perspectives as ‘taxonomic’ and argues that typologies of knowledge are marked by ‘formistic’ type of thinking as typologies are based on the assumption that observable systematic similarities and differences exist between objects of study. He further explains that as tacit and explicit knowledge are mutually constituted – they should not be viewed as separate types of knowledge. Tacit knowledge is a necessary component of all knowledge; it is not made up of discrete means which may be grounded, lost or reconstituted – tacit and explicit knowledge are inseparably related. According to Tsoukas (2001:976) organisational knowledge is the capability that members of an organisation have developed to draw distinctions in the process of carrying out their work, in particular in concrete contexts, by enacting sets of generalisations whose applications depends on historically evolved collective understandings. Based on this perspective, Tsoukas (2001) suggests a ‘constructivist’ view of organisational knowledge emphasising that the content of organisational activities or the social processes and practices surrounding these activities construct and create

organisational knowledge. This supports Leonard–Barton’s (1995) observation that firms nurture and create knowledge through certain activities which basically involve sharing of knowledge within the organisation and the transfer and integration of knowledge across organisational boundaries.

According to Tsoukas (1996) firms are distributed knowledge systems which means that they are composed of knowledge embodied in individuals and their social interactions. The creation of knowledge in such systems requires the promotion of interaction among the individuals situated in various parts. Spender (1996) refers to knowledge emerging from such interactions as collective knowledge. He suggest that a firm’s most strategically important feature is its body of collective knowledge and the key to management impact on a firm is influence over the growth and shaping of this collective knowledge. This is based upon the different ‘organisational practises’, and activities supporting those ‘different practises or ways of doing things’. Lam (2000) proposes four contrasting ‘societal’ models to illustrate institutional variations in the organisation of knowledge and patterns of learning. However she argues that despites the differences important common feature is role of tacit knowledge in generating learning and innovation through societal interactions and practical experiences.

These insights indicate a central role for activities or processes that facilitate interactions among distributed knowledge systems within firms for creating, sustaining or renewing organisational knowledge.

Firm level capability development through human mobility

Immigrant entrepreneurs can quickly identify promising new market opportunities, raise capital, build management teams, and establish partnerships with specialist producers located far away. Saxenian (2006), terming these immigrants new ‘Argonauts’, argues that

the key actors in undermining periphery/core model of technological capability development are communities of technically skilled migrants with work experience and connections to related knowledge centres.

Much knowledge that organisations seek is embedded in individuals. When individuals move between organisations, they can apply this knowledge to new contexts, thereby transferring it (Argote and Ingram, 2000). Thus human mobility can play an important role in the knowledge building processes of hiring firms, especially where knowledge tends to be “sticky” and localised within firms, regions and countries (Szulanski, 1996). Song et al (2003) suggest that human mobility served as a crucial mechanism for the acquisition of knowledge for newly industrialising countries firms. Kim (1997) argued that the mobility of experienced experts can facilitate the transfer of capabilities, permitting further knowledge building, provided the host firm creates the conditions that permit diffusion of knowledge from experts to other employees. Organisational routines and knowledge contributions by returned scientists to them are influenced by relationships between returnees and their existing co-workers which will include existing local workforce. It is therefore necessary to situate role of returned scientists/engineers in knowledge creation and transfer within realm of workplace co-learning and knowledge creation/transfer (Williams, 2006).

The extent to which firms can assimilate externally sourced knowledge is determined, in part, by the nature of the knowledge to be sourced (Kogut and Zander, 1992) and in part by a firm’s absorptive capacity (Cohen and Levinthal, 1990). Even within-firm, tacit knowledge is “sticky” and does not necessarily flow easily unless the individual with the tacit knowledge also moves (Szulanski, 1996). If movement of within-firm tacit knowledge is difficult, its transfer across firms is even more challenging.

Ability to leverage knowledge in new firms varies, depending upon the attributes of hiring firms, and of the mobile engineers and scientists. As organisations experience success, their

routines and processes become more standardised, and this may make it more difficult to assimilate external knowledge (Nelson and Winter, 1982). Path dependence impedes a firm's receptivity to external knowledge by reducing motivation and ability to seek, recognise and assimilate knowledge that differs from current practice. In the case of mobile engineers/scientists, those with stronger innovative capabilities are likely to have more knowledge than those with weaker abilities. However, long years of experience shape behavioural practices and processes and build routines for individuals as well as organisations. This can act as a barrier to knowledge transfer. In such conditions successful knowledge diffusion requires adjustment from firm and individual. Thus, for the newly hired expert, transferring or diffusing outside knowledge effectively into the firm is hard. Nevertheless, much research on human mobility has focused only on investigating the factors influencing mobility, neglecting other core internal firm level factors affecting knowledge diffusion. It is fundamental to identify the challenges and conditions under which human mobility will result in knowledge transfer or diffusion. It is important to analyse how the knowledge possessed by returned scientists is socialised at an organisational level. Furthermore, more investigation of impact of relationships between returned migrants and existing co-workers within firm have on organisational learning and knowledge creation. Therefore, as Argote and Ingram (2000) suggest, further research is needed to assess and understand how people transfer and create knowledge.

3. The Indian Pharmaceutical industry

The Indian pharmaceutical industry is a successful high technology industry, with consistent growth over three decades. It has developed capability to ensure national self-sufficiency in addressing health care needs. Furthermore, its export ability makes it a strategic trade sector. The industry exports generic drugs, including recently to the highly

regulated US and European markets. The Indian pharmaceutical industry is characterised by a low degree of concentration; a low level of R&D intensity with a high level of brand proliferation. Incentives for innovation were undermined by low purchasing capability of the domestic market along with the ease of imitation and horizontal product differentiation; features representative of industries behind the technological frontier.

Indian industrial growth was slow until 1970. The Patent Act of 1972 and government investment infused life into the domestic pharmaceutical industry. The Act removed product patents for pharmaceuticals, food and agro-chemicals, allowing patents only for production processes. The statutory term was shortened to seven years for pharmaceutical patents and automatic licensing was put in place. This started the era of reverse engineering where firms developed new products by changing production processes. From 1970 onwards, Indian pharmaceutical firms slowly started dominating the domestic market reducing the market share and influence of Western companies. Today the market share of domestic firms is around 60-70% compared to 10% in 1970 (See Table 1). Production technologies were mastered and the lag period between the launch of a new product in its first market and then in India reduced, in some cases to as little as two years (Lanjouw, 1996). The Patent Act 1970 allowed Indian firms to adopt 'duplicative imitation' and 'creative imitation' as strategies for technology capability development (Kale and Little, 2007).

(Table 1 Here)

The 1990s saw a number of changes to the regulatory environment. The economy was liberalised and the pharmaceutical sector de-licensed. Production, exports and imports grew impressively after economic reforms (see figure 1). Exports were negligible before the 1970s but started picking up in the 1980s. However export growth of exports has been

rapid since the mid-1990s. The industry grew rapidly in the 1990s, about 15% for bulk drugs and 20% for formulations (Kale et al., 2008).

(Fig 1 Here)

Currently the Indian pharmaceutical market ranks 4th in volume and 13th in value in the world. Production value is estimated at approximately \$4.5 billion with about 5 million direct and 24 million indirect workers. There are two types of firm: organized sector firms and informal sector firms. We estimate the number of pharmaceutical firms at between 20,000 and 23,000, of which about 3,000 are in the organized sector. Of the latter about 90% are small scale firms, i.e. with a capital of less than \$1.25 million (Kale et al., 2008). Overall, the Indian pharmaceutical industry represents a successful case of indigenous self-reliant development aided by weak regulatory framework.

With the signing of WTO agreements, specifically TRIPS in 1994, Indian industry and market structure began to change. Firms identified productive R&D to deliver patentable innovations as a new source of growth. From the 1990s, R&D investment of Indian pharmaceutical industry grew steadily every year (Fig. 2). Chaudhuri, (2007) points out that R&D expenditure has dramatically increased for just one segment of the Indian pharmaceutical industry. Similarly, whilst Indian firms in the past were primarily engaged with development of new processes for manufacturing drugs, now and in parallel they are also involved in R&D for new chemical entities (NCEs) and modifications of NCEs to develop new formulations and compositions (Kale and Wield, 2008).

(Fig 2 Here)

Response of Indian firms to twin challenges

Chittoor et al., (2008) points out key role of indigenous growth model and internationalisation in strategic response of Indian industry to overcome the pressure arising from these dual institutional changes. Kale et al., (2008) goes further and reveals variation of strategies which formed the part of 'indigenous growth model'. They showed that Indian firms adopted different combinations of strategies such as entering generic markets of advanced countries using process innovations; offering services to MNC firms; importing innovations; and investing in new drug discovery research.

(Figure 3 here)

Indian firms' R&D is focused into 3 areas: innovative product R&D towards development of new chemical entities (NCE); modifications of existing NCEs; and, innovative process R&D to develop generics with non-infringing processes.

Generic product R&D involves creation of non-infringing processes or sometimes invalidation of an existing patent. The knowledge base underlying generic product R&D builds on organic and synthetic chemistry skills accumulated in reverse engineering but adds a patentable innovative element, providing value for the firm. Indian firms developed generic product R&D competencies by building on strong synthetic and organic chemistry skills and leveraging process R&D capabilities.

Some firms started offering services to multinational firms in manufacturing as well as R&D. In manufacturing, firms offered cheap production of bulk and formulation drugs. For example in 2003, NPIL signed its first custom manufacturing contract with the US firm Advanced Medical Optics, Inc. for manufacturing select eye care products for their global markets – including US, Japan and Europe.

Some firms have in-licensed innovations from US and UK biotechnology firms, working as partners in development of these in-licensed products which can be marketed in a TRIPS regulatory environment. For example Nicholas Piramal signed an in-licensing agreement with the French firm Ethypharm for licensing of technology for Paracetamol Flash tablets, effective in the Indian paediatric market.

In parallel, some Indian firms adopted the ambitious strategy of innovative product R&D to develop new chemical entities and new drug delivery systems. However innovative product R&D requires a different knowledge base and organisational capabilities, bringing new challenges.

New challenges of innovative R&D – Knowledge

During the last three decades the larger firms have focused on reverse engineering oriented process R&D. Indigenisation through imitation rather than innovation made R&D in Indian pharmaceutical firms insular. As a result Indian firms have accumulated extensive knowledge in process R&D (synthetic and organic chemistry) but have severe weaknesses in other scientific disciplines such as medicinal chemistry and biology. Ease of imitation resulted in intense competition for market share, hampering development of a collaborative web of networks of research institutes, academia and industry. Absence of collaborative R&D networks and lack of medicinal chemists and biologists created a severe knowledge gap for Indian firms in their move to innovative R&D. In addition, the decades of reverse engineering R&D shaped the mindset of existing scientists towards imitation. Transformation towards innovative thinking was a key challenge.

Kale (2005) found that firms are filling knowledge gaps in innovative R&D by hiring US-based Indian scientists, with experience of innovative research in multinational

pharmaceutical firm R&D. Not only are these scientists a valuable source of knowledge but they also provide firms with entry into technology networks in advanced countries.

However an ex-R&D president of Dr Reddy's Laboratories (DRL) explains that barriers exist to the attraction of senior scientists:

“people who have settled jobs in big multinationals must have stayed there more than eight to ten years. They are used to the American style of living and enjoy all the major benefits of a multinational work culture, scientific environment, physical comfort and attractive salaries. For them to leave all that and come with kids can be a problem because if kids were born there and are going to those schools it will be a major displacement for them to return. Also their spouse is also working there, all these factors add up”.

Returning senior scientists have concerns. The Chief Scientific Officer of Nicholas Piramal Industries Ltd (NPIL) describes some:

“There were concerns. One, working for an [Indian] family owned company is very different than working for a company in the US, mostly a public company. So that certainly was a concern; I had a friend who was working here in a company in India and he had disagreements with the chairman and was fired the next day. So I had heard those kinds of stories. The other concern was whether drug discovery research could really be done in India. First, I have already alluded to you earlier how quickly can you change direction and implement your ideas and how quickly can you execute them - because pharmaceutical R&D is very competitive and medical knowledge changes and based on that you may have to stop what you have been doing for 2 or 4 years and quickly take a left turn or right turn, whatever is necessary. I was very concerned about the hierarchical system that I knew

existed in India. Then of course the manpower; how well trained would scientists here be in terms of drug discovery”.

Another key issue is government policies and social infrastructure. An ex-R&D president of DRL indicates that Indian firms’ efforts are not enough:

“they expect first a good scientific environment, it is very important. The second thing is that their kids get a good education and the third thing is of course salary; combination of these three things. They expect to live a decent life, enjoy all corporate benefits”.

Thus, the development of innovative R&D competencies in Indian pharmaceutical firms provides an interesting case to explore knowledge acquisition through human migration.

4. Research Methodology

This research is focused on the social processes adopted by Indian pharmaceutical firms to effective transfer of knowledge through human mobility. The Indian specific contextual elements (such as working environment in Indian pharmaceutical firms, institutional settings and local human resource) need to be considered in exploring processes of attraction and assimilation. In this ‘context’ a case study research strategy was selected to allow all contextual conditions and social processes to enter into analysis (Yin, 1994).

Kale (2005) found that innovative Indian pharmaceutical firms are filling knowledge gaps in innovative R&D by hiring the US based Indian scientists, who have experience of innovative research in multinational pharmaceutical firm’s R&D. Therefore these Indian pharmaceutical firms used as case studies to identify issues involved in transfer of knowledge through human mobility.

This research focuses on five firms: Ranbaxy Laboratories, Dr. Reddy's Labs, Lupin, Nicholas Piramal and Glenmark laboratories. All these firms are family owned firms operating in service and generic markets of Europe and USA. These are ranked amongst the top Indian pharmaceutical firms in both market share and for innovative R&D output. They have consistently filed patents with Indian as well as US patent offices.

All these firms have consistently increased R&D investment from 2000 and established R&D labs dedicated to innovative R&D (Table 2). Table 3 provides R&D intensity; percentage of R&D investment to the turnover of Indian firms from year 2000 to 2007. Ranbaxy is the largest R&D investor in the pharmaceutical industry reaching US \$144.40 million in 2006. DRL is the second largest spender with higher R&D intensity, which has increased steadily and sharply from 2000 to 2006 reaching 17.12% in 2004.

(Table 2 here)

The number of scientists working in Indian firms has grown considerably in the last decade (table 4). These firms are heavily recruiting scientific staff to create a critical mass of innovative R&D experienced scientists. As a result the percentage of staff working in innovative Indian pharmaceutical firms has grown consistently.

(Table 3 here)

Data Collection and Analysis

Primary data was collected through interviews with scientists working in the four firms and others (presidents of Indian pharmaceutical associations, pharmaceutical consultants).

In parallel, interviews were conducted with members of Indian branch of the American Association of Indian Pharmaceutical scientists (AAiPS). These interviews provided crucial evidence regarding movement of Indian scientists from US to Indian pharmaceutical firms since the AAiPS coordinates networking activities between scientists working in India and US. Field study involved 2 visits to India and 1 to the USA. In India 24 interviews were conducted; while in the USA 7 interviews were conducted. Interviewees included 3 ex-R&D presidents, 5 R&D presidents, 6 senior scientists, 4 returned scientists and 2 non returned scientists.

The interview questions focused on the relationship between policies and scientist activity in the hiring firms. The semi structured interview focused on questions such as:

- What are the tensions involved in bringing back the foreign educated Indian scientists?
- What is the impact of management policies in facilitating the diffusion or transfer of knowledge?
- What policies, resources and capabilities firms should have to acquire knowledge through human embodied transfer?

Data analysis

The qualitative data were analysed by using pattern matching (Yin, 1994) and analytical tables (Miles and Huberman, 1984). A strategy of pattern coding is used to identify and code organisational processes and issues involved in attraction, retention and assimilation which emerged in transcripts. In the analysis first level coding is used as a device for summarising segments of data while pattern coding is carried out by grouping those codes into a smaller number of overarching themes or constructs. The theoretical framework provided broad categories for classification of the data and various pattern codes are classified under those broad categories. The replicating patterns of internal organisation

social processes and issues were identified. These patterns were supplemented by secondary data which were collected from industry journals, industry association publications and annual reports of firms.

5. Firms under study

Ranbaxy Laboratories Limited

Ranbaxy, India's largest pharmaceutical firm, is ranked amongst the top ten generic companies in the world. Ranbaxy's initial forays into research and development activities began in the late 1970s. In 2008 Daichi Sanyo acquired major stake in the company.

In the 1990s Ranbaxy began to change focus from process R&D to new drug discovery research (NDDR) and NDDS initiatives. In 1999 Ranbaxy registered its first success with the development of once-a-day dosage for the Ciprofloxacin molecule. By 2006 Ranbaxy had established 3 state of art R&D centres for innovative pharmaceutical R&D.

Despite having a few molecules in clinical and preclinical trial stages, by 2002 most R&D was still in generics. Ranbaxy needed more scientists with experience in state of the art drug discovery technologies. To fill knowledge gaps Ranbaxy started hiring Indian scientists based in, multinational R&D laboratories in the US and Europe.

Ranbaxy's R&D size and infrastructure and success with Ciprofloxacin helped the company to encourage 'reverse brain drain'. In 2003, Ranbaxy hired Dr. Rashmi Barbhैया, who was vice president of drug discovery in Bristol Mayer Squib (BMS) as its R&D President. Then, Ranbaxy hired Dr. Batra from Schering-Plough Research Institute in the US, as a new Vice-President, Pharmaceutical Development to lead the development of new chemical entities and new drug delivery research. In 2003, under the leadership of Dr. Barbhैया, Ranbaxy took some key decisions regarding future R&D direction. In 2004 Dr. Rajinder Kumar, previously global head of clinical psychiatry R&D at

GlaxoSmithKline (GSK), took charge of Ranbaxy's R&D with responsibility of accelerating company's drug discovery effort.

However Ranbaxy faced difficulties in retaining returned scientists as Dr. Bharbhैया left the company after 3 years and Dr. Rajinder Kumar after 11 months. An ex-R&D President of Ranbaxy explains:

“first, the people they brought in were specialised in one subject. R&D consists of multiple disciplines and one should bring men who understand almost every discipline. One person came here with pharmacokinetics background. Pharmacokinetics is not even 1% activity of total R&D. Also, he has never done generic R&D in his life so there was a total vacuum. Another man came with a clinical research background. But Ranbaxy hardly does clinical research. They maybe have only one compound. So it was a mismatch actually”.

Keeping with trend of hiring overseas talent at senior R&D positions, Ranbaxy appointed Dr. Pradip Bhatnagar as the Senior Vice President of Drug Discovery Research from GlaxoSmithKlin Beecham. Prior to joining Ranbaxy, Dr. Bhatnagar had 23 years R&D managerial experience in various positions at GlaxoSmithKline. By 2009 Ranbaxy R&D staff has 120 master's- and Ph.D.-level chemists working in discovery areas searching for leads in infection, metabolic disorders, urology, and inflammation

Dr. Reddy's Laboratories Ltd

Dr. Reddy's Laboratory (DRL) has emerged as the first Indian pharmaceutical company to discover a new chemical entity and license it to a MNC pharmaceutical firm. Recognising the importance of innovative basic research in post-2005 India, DRL built the Dr. Reddy's Research Foundation (DRF) in 1992. DRF is exclusively dedicated to research in the area of new drug discovery and was the first private pharmaceutical firm to undertake basic

research. DRF's NCE drug discovery research is focused on Metabolic Disorders, Cardiovascular Indications and Cancer.

Within three years of starting innovative research DRF discovered one of the most potent glitazones, Ragaglitazar. Soon, DRF began evaluating its R&D capabilities and started hiring scientists to fill knowledge gaps. In 1997, it became the first Indian pharma company to ,out-license an original molecule an anti-diabetic molecule to Novo Nordisk.

DRF focused on hiring fresh scientists to work in drug discovery R&D and so identified Indian students studying abroad on doctoral and post doctoral courses. In DRF, almost 15% of research staff working in discovery R&D are recruited from overseas. For 80% of R&D scientists, it was their first job. DRF's former R&D president elaborates the recruitment strategy adopted by the firm:

“We accelerated our plans to do drug discovery research and at that time we certainly wanted to recruit top-notch talent. Fortunately there was no competition in India. Nobody else was looking for scientists for drug discovery. It was relatively easy for us to attract the talent given the world class infrastructure we created. Every scientist returning from US was visiting us or corresponding with us asking about our plans. So we recruited really top notch talent”.

After establishing discovery research in Hyderabad, DRF wanted to introduce leading edge skills such as drug discovery based on genomics and proteomics. It wanted to move from analogue research towards target based discovery or rational drug design but struggled with this change. The former R&D president described the situation:

“we could not recruit the requisite skills because it’s not one scientist, you need a whole team and we could not do this quickly. We located scientists, 1 or 2 were willing to come out, but they had inhibitions and they needed a lot of time and were unable to take quick decisions. Then we decided there is no point in waiting. We cannot bring people here; we will move our lab there”.

Therefore in 2000, DRF set up a lab in Atlanta, US dedicated to discovery and design of novel therapeutics. The lab, Reddy US Therapeutics Inc (RUSTI), has primary aim to conduct drug discovery using molecular genomics and proteomics approaches. DRL recruited Dr. Uday Saxena as CSO of its Atlanta subsidiary and within two months RUSTI built a team of 12 scientists however after eight years in 2008 Dr. Uday Saxena left DRL. In 2007 Dr. Rajinder Kumar joined DRL as a president of research development and commercialisation after leaving Ranbaxy.

DRL figures show that employee retention is well above industry average, and it has been able to grow its business through the acquisition of U.S.- trained talent.

Nicholas Piramal (I) Ltd

In 2003 Nicholas Piramal India Limited (NPIL) became the 4th largest Indian pharmaceutical firm with 4.4 % market share. NPIL is part of Piramal Enterprises, one of the India’s largest diversified business groups.

Innovative R&D forms an important constituent of NPIL post-2005 strategy. It is based on the idea of developing product patented molecules to Phase II and then licensing them to multinational firms. In 1998 NPIL forayed into innovative R&D by acquiring the research centre of Hoechst Marion Russell located in Mumbai, India.

Hoechst is one of the oldest research centres in India exclusively working on drug discovery. It has been in existence from 1972 and always focused on new drug discovery research and herbal research. In 2005 NPIL opened a state-of-the-art R&D laboratory totally dedicated to the development of innovative pharmaceutical R&D.

NPIL has rapidly built a dedicated team of scientists with expertise in medicinal chemistry, biological science, analytics and pharmacology and hired international consultants to guide its drug discovery research. From 2000 NPIL started creating a critical mass of scientists with expertise in various areas of pharmaceutical R&D. By 2008 Piramal's R&D centre had a team of 45 medicinal chemists focused on oncology, diabetes, and anti-inflammatory diseases.

In 2002 NPIL hired Dr. Somesh Sharma as Chief Scientific Officer to lead its innovative R&D effort. He was the Vice President of the Monoclonal Antibody and Vaccine Unit at Anosys Inc, US. Dr. Sharma was in the USA from 1967 where he obtained a Doctorate in Pathology from the University of Maryland's School of Medicine. He has co-founded companies like Anergen, Wizard Laboratories, S2 Pharmaceuticals and Calyx Therapeutics. In 2004 NPIL hired Dr. Maneesh Nerurkar from Merck as head of formulations and new drug delivery systems to strengthen company's new drug delivery efforts. In NPIL, a total of around 60 scientists have experience of working abroad, 20% of its R&D work force.

Lupin Laboratories Ltd

Lupin is a dominant leader in the anti-TB segment of the Indian domestic market with 42% market share in 2003. Lupin also exports to more than 50 countries. 41% of sales in 2003 came from exports; although mainly in the form of bulk drugs or active pharmaceutical ingredients to semi-regulated markets.

In 2001 Lupin decided to engage in innovative R&D and built a state of the art R&D laboratory in Pune, India. Lupin is new to innovative pharmaceutical research. Lupin hired, from Ranbaxy, Dr. Himadri Sen as Executive Vice-President of Pharmaceutical R&D and Dr. Sudershan Arora as Executive Vice-President, to lead the company's innovative R&D. In Ranbaxy Dr. Sen had been in charge of NDDS (new drug delivery research) while Dr. Arora was in-charge of new chemical entity research. Ranbaxy brought both of them from overseas to lead company's projects in innovative R&D.

Lupin has adopted a different hiring strategy. Rather than scouting talent from abroad, it hires talent that has already returned to work in other Indian firms. Lupin's R&D vice presidents for new drug delivery systems and new chemical entities are returnees but first joined other Indian firms, only later moved to Lupin. Hiring proved successful in building a core team with expertise in drug discovery as other scientists working in Ranbaxy also joined Lupin. By 2009 Lupin developed a team of 27 medicinal chemists to search for leads for diabetes and rheumatoid arthritis.

However Lupin faced severe challenge in retention of these acquired talents. In 2008 both Dr. Sen and Dr. Arora left Lupin laboratories and joined Ranbaxy Laboratories as R&D President and President Drug and Clinical Trial Development.

6. Discussion and Analysis

These snap-shot case histories reveal five important insights:

There are major generational differences in return migration

Return migration is happening at two levels; at senior scientist and post-doctorate levels. This two-level migration has implications for firm strategy as each group has different

requirements and expectations. At the post-doctorate level, a scientist is mainly concerned about learning new skills and finds it comparatively easy to be assimilated in the firm. At senior scientist level, concerns were focused on the long term future of the firm and the role a scientist can play in creating that future. An ex-R&D president of DRL explains:

“the guy who has worked there for 10 years in a MNC and is a US citizen, things like long term growth plan of firm and other things matters. But for post-docs who were only abroad for 3-4 years; they have advanced skills, are enthusiastic and energetic. For them immediate landing into a research position is more important than long term things. It is important for them that the first five years go well for them because there are so many R&D centres they can switch job to after that”.

Sectoral differences between software and Pharma regarding technology and people

In software, professionals take a more hands off approach to work by travelling between India and US but that is not really possible in pharmaceutical R&D. Many Indians working in Silicon Valley contributed to the growth and knowledge of the Indian software industry by setting up units in India whilst working in the US. In the case of pharmaceuticals, scientists working overseas cannot operate hands-off. The nature of technology and work requires relocation. Technological differences include the need for wet labs and hands-on experimentation. In drug discovery research a scientist has to be present in a laboratory to oversee experimentation, findings and evaluate the future action. The cross-disciplinary nature of drug discovery research means that experimentation and evaluation of results require input from scientists associated with different disciplines such as chemistry, biology and pharmacokinetics. In the case of software development a programmer can write a code based on instructions provided by a distant project manager. Thus, in software Indian

professionals could maintain their links overseas by avoiding complete relocation and at same time contribute to the growth of Indian industry by providing needed skills and access. However, in the case of the pharmaceutical industry such an arrangement is difficult to embed since complete relocation results in loss of links.

This difference suggests important relationship between knowledge transferability and types of knowledge. Knowledge dependent on conceptual skills, cognitive abilities and independent of physical presence have more potential to transferability such as observed in IT industry. In pharmaceutical R&D nature of knowledge requires working of scientists in together within specific context. R&D knowledge is a resultant of physical presence such as project team working together and it is rooted in practical thinking with specific context, learning in doing and share experiences making knowledge creation and transfer a challenging process.

There is a mismatch between the requirements of Indian firms and the skill sets offered by returning scientists

Indian firms are still new to innovative pharmaceutical R&D. Thus, they require scientists who have knowledge in a wide range of pharmaceutical R&D areas whereas returning scientists had mainly specialist capabilities. Mismatch between the requirements of firms and scientists skills constrains effective diffusion of knowledge in Indian firms. The R&D president of an Indian firm elaborates:

“we are seeing a significant number of people who are interested to come back to India. They are coming. But if you look at a person who is working in a Glaxo or Pfizer, the typical applicability of that type of talent to India is not exactly correct. There is a

mismatch because they work in highly specialised subjects and specialised departments in places like Glaxo. So the guy who is doing specific molecular biology work, even within molecular biology he will be doing only one type of cell line. But that type of specialisation at this early level is bad for Indian companies. So they are picking up people from post-doc level rather than senior. In a Glaxo, doing something at 10-15 million dollars is nothing. In a typical Indian company they will try to complete an entire project for 15 million dollars. Skill sets from start-up biopharmaceuticals companies may be much better suited to India rather than people from the big companies”.

There are differences in working culture in Indian firms and western firms

Indian firms are family owned businesses that have mainly grown on the basis of reverse engineering R&D capabilities. The R&D intensity of Indian firms has grown steadily but is still less than multinational firms. R&D investment is a lot less and scientists who have worked overseas in senior positions find difficulties in adjusting to budget. Over the years Indian firms have grown via generics with a fast return on R&D investment. However innovative R&D requires longer period for investment returns and Indian firms are still learning the processes of innovative R&D.

Indian firms expect to see tangible results after over a decade of investments into innovative research is creating difficult situations for returned scientists. Indian firms have set performance benchmark unreasonably high due to high expectations from returned scientists. This is creating unsustainable pressure on senior scientists to show tangible results within short period of time. This impatience on part of management is leading to the lack of coordination between scientists and the top management and this lack of management support is severely affecting research success rate. Dr. Swaroop Kumar, ex head R&D Glenmark explains,

“Firms need a clear-cut strategy when it comes to R&D. Entry and exit strategies shouldn’t be designed by scientists alone and right from the start of a project, you should have a clear idea of which companies would be interested in developing the drug further.”

Thus adjustments required on top management side are difficult and result in pressure on overseas scientists to deliver performance in a very short time.

Motivation of returning scientists specifically those coming back at postdoctoral level

Scientists returning at post-doc level view working in an Indian firm as a good opportunity to learn leadership and management skills. Indian firms offer returning post-doc scientists positions in middle management, allowing them to gain experience of managing and leading projects. Working overseas in big MNC firms gives Indian scientists the opportunity for specialised work in small project teams whereas Indian firms hire post-doc scientists as project managers with considerable freedom to develop projects. This helps them create project management skills and thus gain important career experience. In 2008 Glenmark Pharmaceuticals, which has been on the forefront of research lost its R&D chief Swaroop Kumar. Kumar left the Glenmark to pursue his own research venture in Hyderabad.

Finally, our research results also show the importance of social infrastructure on the decision-making of returning US based Indian scientists, suggesting that there is an important role for government policy in providing and establishing adequate physical and social infrastructure.

7 Indian firms’ strategic HR response to assimilation challenges

In the post-TRIPS environment Indian firms are competing with global MNCs for world class research talent and must thus make sense of rapidly changing global business. Firms realised that in innovative R&D there are too many jobs chasing too few candidates and gaps must be filled by attracting and retaining talent from around the world. These firms have transformed R&D management practices by committing considerable tangible and non-tangible investment in the development of scientists by aligning individual ambitions with larger organisational goals. The HR processes in these organisations were redesigned to deliver innovations and at the same time cater to individual career requirements.

Adopted innovative HR strategies to locate and attract potential scientists

Some Indian firms use links with Indian universities and institutes to identify and attract scientists, specifically experienced post-doctorate and recent PhDs. These firms also help scientists pursue their academic ambitions while working with them. They have established relationships with leading universities in India and started collaborative courses for their staff. The research centres of all four case-study firms have been recognised by reputed Indian universities as authorised PhD centres so post graduate scientists can commence their doctoral degree whilst working in the firms. For example Ranbaxy, DRL and NPIL have established strong links with Delhi University, BITS Pilani and University of Mumbai respectively. Due to such affiliations the researchers in these firms have access to university facilities such as library and laboratories. This has helped their efforts to upgrade research skills of R&D staff. Firms use these relationships with universities and research institutes to get information on good students.

(Table 5 here)

An ex-R&D president of Dr Reddys Laboratories (DRL) explains:

“the mentors of post-docs were known to me, known to some of us. Post-docs were valuable and it was relatively easy. But to attract somebody who worked in a MNC in the US was difficult and is indeed still difficult today”.

Indian firms are responding to challenges of severe attrition at top level by creating new ways project management. For example after Glenmark lost its R&D president company hired a new chief medical officer based abroad, and a former employee of Pfizer, in role of vice-president for drug development as a replacement to Kumar.

Created leadership positions for new scientists

Indian firms attract scientists by giving them independent charge of drug discovery projects so they learn leadership and R&D management skills. As we reported earlier, firms offer returning post-doc scientists positions in middle management. Post-doc scientists get considerable freedom to develop projects, to create the skills of managing projects and thus gain important experience for their future careers. For example DRL’s head of API R&D in Hyderabad is a former professor of chemistry from Texas A&M University. He was head at the Roche facility in Mexico and will now head the company’s Centre of Excellence for Engineering to help build engineering excellence and improve chemical capabilities at all the chemical plants.

The ex-R&D president of DRL explains,

“They are here at director level, we are giving them leadership positions, we are giving them a position which is going to lead into the management of the organisation, management of the scientific programme, not just running a small lab and all that, supervising few people but they are participating in decision making. Such a thing is not possible there”.

Developed new training programmes and incentive systems

Indian firms now provide training support to enhance scientists' research skills and scientific knowledge bases. Scientists rotate labs to evaluate their aptitude and skills. They are given independent tasks like designing a research programme, then getting the opportunity to work on it. Scientists are encouraged to design their own molecules. Patent analysis provides scientists with an understanding of the intricacies involved in innovative drug discovery. Indian firms have changed their appraisal systems and offered new financial as well as work related incentives like attendance at important conferences, training in overseas university and institutes based on the scientists performance.

R&D president of DRL explains,

“From day one we brought all the multinational concepts to the Indian company. They vary; individuals should be or job should be evaluated and then it should be told to them what is expected out of him for the coming six months or one year; what we call performance appraisal systems. So we evaluated them and contributions are measured in very scientific way. How much they promised and how much they delivered? ...if the molecule become sort of impressive and we could out license molecule then we ‘incentivise’ them by giving whatever milestone payment we were getting”

Indian firms are investing steadily to attract and retain talent from all over world by launching new schemes where top performers can earn up to three times their variable pay component. For example DRL's employee costs have been increased from 6 % of sales in 2001 to 18% in 2006. Similar trends are also observed in other firms.

Influenced by Indian IT firms' HR practises to attract and retain IT engineers

Indian IT firms devised innovative HR management practises to attract and retain talented IT employees. Indian pharmaceutical firms are now employing similar practises to retain

and absorb overseas scientists. For example when DRL started redesigning HR processes, it discovered that there were no good models in pharma industry but found revolutionary HR systems in Indian IT companies inspiring. Thus it hired its HR president and vice president from two leading Indian software firms. In 2002 DRL also hired G. Rajkumar, general manager (learning and development) from Infosys, a leading Indian software firm to run education of technical staff in intellectual property skills and project management skills.

Pharmaceutical firms' launched new initiatives such as performance linked pay, attractive stock options schemes, performance management systems and leadership development programmes and benchmarked them against IT firms.

8. Conclusion

This paper addresses two major gaps in the neglected field of international migration, knowledge and learning. First, it seeks to conceptualise how migration contributes to knowledge creation and transfer, drawing on literatures in knowledge management and migration studies. Second, it shows difficulties associated with knowledge transfer through human migration and the need for greater understanding of complexities associated with learning and knowledge transfer. It evidences that assimilation of knowledge from returned scientists is not a straightforward process and firms have to make major efforts to facilitate diffusion of knowledge.

One of the most important studies of transnational communities' contributing to development of their home country is that of Asian-American networks in Silicon Valley, based on the information and communication technology sector.. Seguin et al., (2006) point out that experience of Silicon Valley transnational communities have received much attention in migration literature but there is a lack of in-depth case studies of other multi-

ethnic S&T clusters from which comparisons can be drawn. They further point out that Silicon Valley studies focus on Information and Communication Technology, thus limiting generalisation. This paper builds on that and studies migration issues in different technological sector, the pharmaceutical industry.

This paper reveals: generational differences of returnees; differences in the working culture of Indian firms and western firms. Importantly, it shows that significant differences between the requirements of Indian firms and skills sets of returnees hamper effective knowledge diffusion

This paper show that Indian firms responded to these issues by transforming Indian firm R&D management practises and adopting global R&D management practices. Firms introduced matrix styles of R&D project management, changed incentive structures and adopted less hierarchical R&D management systems. Firms provided support to returnees to adjust to their new environment by facilitating their settling into their new living bases. Indian firms' HR initiatives were also influenced by HR policies used by Indian software firms to attract and retain high-flying software engineers.

The insights from firm HR practices contribute to the emerging literature on the changing nature of work as organisations address globalisation-related challenges like increased competitiveness, institutional convergence and higher premiums on skills and creativity. The innovative HRM strategies and practices from Indian firms indicate a proactive process recognized in the human resource literature (Lengnick-hall and Lengnick-hall, 1988). Thus this paper makes a significant contribution to the literature focused on role HR strategies in transforming and facilitative firm's innovative competencies

This paper shows that transfer of tacit knowledge is facilitated and sustained by human mobility and returned migration is one way in which emerging country firms can get access to tacit knowledge. However this paper also points out that there are limits to

transferability of some types of knowledge and requires specific processes for each type of knowledge diffusion. In this regard more research needs to be done on how different types of tacit knowledge are transferred by different channels – including different forms of migration – within such communities of practice.

The phenomenon of return migration in Indian pharmaceutical firms is quite recent and creates difficulties in collecting quantitative data. This is one of the limitations of the paper. Unlike Indian IT firms and industry association, Indian pharmaceutical industry association and firms are yet to start preparing a separate account of returnees.

8. References

Argote, L. and P. Ingram (2000) “Knowledge transfer: A basis for competitive advantage in firms”. *Organisational Behaviour and Human Decision Processes*, 82(1), 150-169.

Chaudhuri, S. (2007), ‘Is Product patent protection necessary in developing countries for innovation? R&D by Indian pharmaceutical companies after TRIPS’, *Indian Institute of Management, Calcutta. WPS No. 614*

<http://www.iprsonline.org/resources/docs/Sudip-WP-India-R&D-TRIPS-Sept-2007.pdf>

last accessed on 10th March 2008

Chittoor, R., S. Ray, et al. (2008). "Strategic responses to institutional changes: 'Indigenous growth' model of the Indian pharmaceutical industry." *Journal of International Management* 14: 252-269.

Cohen, W., M. and D. A. Levinthal (1990) “Absorptive capacity: A new perspective on learning and innovation” *Administrative Science Quarterly* 35: pp128-152.

Cook, S. D. N. and J. S. Brown (1999) "Bridging epistemologies: the generative dance between organisational knowledge and organisational knowing." *Organisational Science*, Vol. 10, No. 4, pp 381-400

- Kale, D (2005) *Re-developing knowledge creation capability: Innovating in the Indian pharmaceutical industry under TRIPS regime*, unpublished PhD Thesis, The Open University, UK
- Kale, D. J and Little, S. E (2007), 'From Imitation to Innovation: The Evolution of R&D capabilities and Learning Processes in the Indian Pharmaceutical Industry', *Technology Analysis and Strategic Management*, 19 (5), 589-611.
- Kale, D. and Wield, D (2008) Exploitative and explorative learning as a response to the TRIPS agreement in the Indian pharmaceutical firms, *Industry and Innovation*, 15 (1), 93-114
- Kale, Athreye, and Ramani (2008) Experimentation with strategy and the evolution of dynamic capability in the Indian Pharmaceutical Sector, *UNU-MERIT Working paper*, 2008-041
- Kim, L (1997) The dynamics of Samsung's technological learning in semiconductors, *California Management Review*, 39 (3), 86-100.
- Kogut, B and Zander (1992) "Knowledge of the firm, combinative capabilities and the replication of technology", *Organisational Science*, 3 (3), 383-397
- Lam, A. (2000). "Tacit knowledge, organisational learning and societal institutions: An integrated framework." *Organisation Studies* 21(3): 487-513.
- Lanjouw, J. O. (1996). "The introduction of pharmaceutical product patents in India: Heartless exploitation of the poor and suffering?" *NBER Working Paper*. Washington D.C
- Legnick-Hall, C.A. and Legnick-Hall, M.L. (1988) "Strategic human resource management: A review of literature and proposed typology". *Academy of Management Review*, 13 (3), 454-470
- Leonard- Barton, D (1995) *Wellsprings of knowledge: building and sustaining the sources of innovation*, Harvard Business School press, Boston, Massachusetts
- Miles, M., & Huberman, M. (1984) *Qualitative Data Analysis*, London: Sage Publications

- Nelson, R. and S. Winter (1982), *An evolutionary theory of economic change*. Harvard University Press. Cambridge, Massachusetts
- Nonaka, I and Takeuchi, H (1995) *The knowledge creating company: How Japanese companies create the dynamics of innovation*, Oxford, Oxford University Press
- Polanyi, M. (1966) *The Tacit dimension*. London, Routledge & Kegan Paul
- Saxenian, A L (2002) Trans-national communities and the evolution of global production networks: The case of Taiwan, China and India, *Industry and Innovation*, Special issue on Global Production Networks, Fall
- Saxenian, A L (2006) *The New Argonauts*, Harvard University Press.
- Seguin Beatrice, State Leah, et al., (2006) "Scientific diasporas as an option for brain drain: re-circulating knowledge for development." *International Journal of Biotechnology* 8(1/2): 78-90
- Song, J; Almeida, P; Wu, G (2003) "Learning by hiring: when is mobility more likely to facilitate inter-firm knowledge transfer?" *Management Science*, 49 (4), 351-365
- Spender, J.C. (1996) "Making knowledge the basis of a dynamic theory of the firm", *Strategic Management Journal*, Vol.17, Winter Special Issue, pp.45 - 62
- Spender, J.C. and Grant, R (1996) "Knowledge and the firm: Overview", *Strategic Management Journal*, Vol.17, Winter Special Issue, pp.45 - 62
- Suzlanski, G (1996) "Exploring internal stickiness: Impediments to the transfer of best practices within the firm", *Strategic Management Journal*, 17(Winter Special Issue), 27-43
- Teece, D; Pisano, G; Shuen, A. (1997) "Dynamic capabilities and strategic management" *Strategic Management Journal*, Vol. 18:7, pp 509-533
- Tsoukas, H. (1996) "The firm as a distributed knowledge system: A constructionist approach." *Strategic Management Journal*, 17 (Winter special issue), pp 11-25.
- Tsoukas, H. (2001) "What is organisational knowledge?" *Journal of Management Studies* Vol. 38, No. 7, pp 973-993.

Tsoukas, H., & Mylonopoulos, N. (2004) "Introduction: Knowledge construction and creation in organisations", *British Journal of Management*, 15(1), 1-9.

Williams A. M (2006) "Lost in Translation? International migration, learning and knowledge", *Progress in Human Geography*, 30(5), 588 – 607.

Yin (1994) *Case study research – Design and methods*, 2nd edition, Sage publications

Tables

Table 1: Top ten pharmaceutical companies in India from 1970 to 2003

rank	2003 Company (market share)	1996 Company (Market Share)	1970 Company (Market Share)
1	GlaxoSmithKline* (5.6)	Glaxo-Wellcome* (4.97)	Sarabhai (4.97)
2	Cipla (5.5)	Cipla (2.98)	Glaxo* (2.9)
3	Ranbaxy(4.7)	Ranbaxy (2.67)	Pfizer* (2.6)
4	Nicholas Piramal (3.4)	Hoechst- Roussel*(2.6)	Alembic (2.6)
5	Sun Pharma (3.1)	Knoll Pharma* (1.76)	Hoechst* (1.7)
6	Pfizer* (2.7)	Pfizer* (1.73)	Lederly* (1.7)
7	Dr. Reddy's (2.6)	Alembic (1.68)	Ciba* (1.6)
8	Zydus Cadila (2.5)	Torrent Pharma (1.60)	May & Baker* (1.6)
9	Abbott* (2.3)	Lupin Labs (1.56)	Parke Davis* (1.5)
10	Aventis – includes merger with Hoescht * (2.2)	Zydus-Cadila (1.51)	Abbott* (1.5)

*** indicates a multinational firm**

(Source: OPPI, 2000, 2004)

Table 2 R&D intensity of case study firms (Source: Annual Reports 2000-2007)

Firm	No. of R&D labs	2000	2001	2002	2003	2004	2005	2006
Ranbaxy	3	4.20	3.80	5.20	6.10	9.35	17.41	13.28
DRL	5	4.22	6.29	7.70	10	17.12	10.85	9
NPIL	2	1.80	2.16	1.63	3.90	8.29	6.04	5.1
Lupin	1		2.41	3.5	4.0	7.2	6.7	7.2

Table 3 R&D scientists/ total employee ratio (Source: Annual reports 2000-2007)

Firm	2000	2001	2002	2003	2004	2005	2006
Ranbaxy	8.85	9.02	11.11	13.52	9.75	10.36	9.69
DRL		9.09	12.39				10.45
NPIL	2.66	3.38	4.53	4.33	4.6	5.04	5.20
Lupin			5.45	6.11	5.40		6.66

Figures

Figure 1: Turnover and export growth in Indian pharmaceutical Industry (Source: Kale et al., 2007)

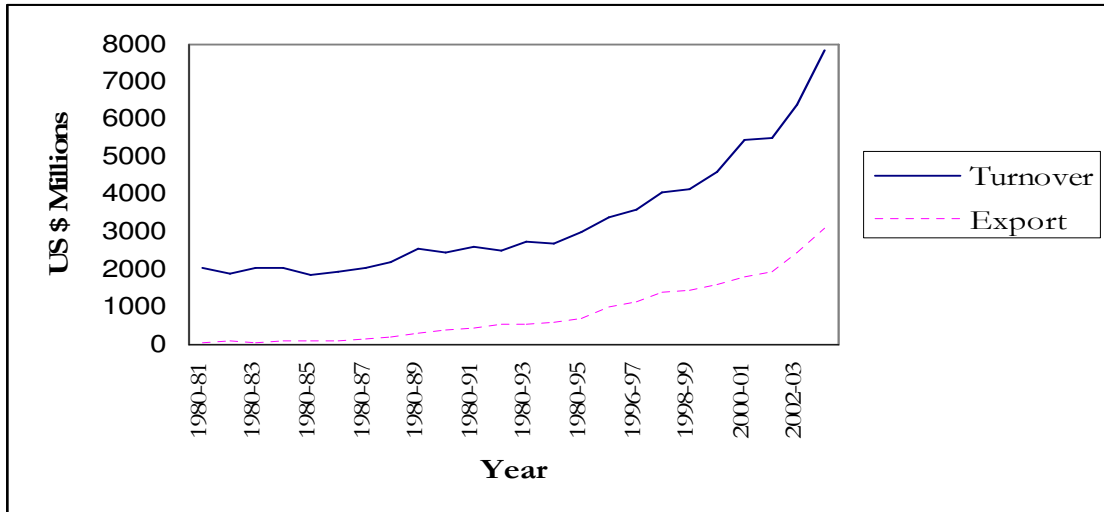


Figure 2 R&D expenditure of Indian pharmaceutical industry (Source: OPPI, 2004)

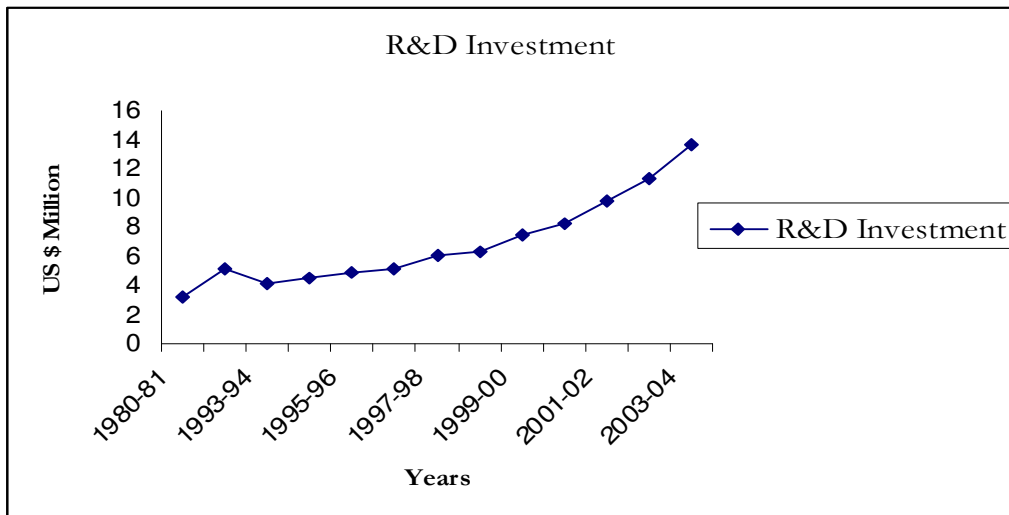
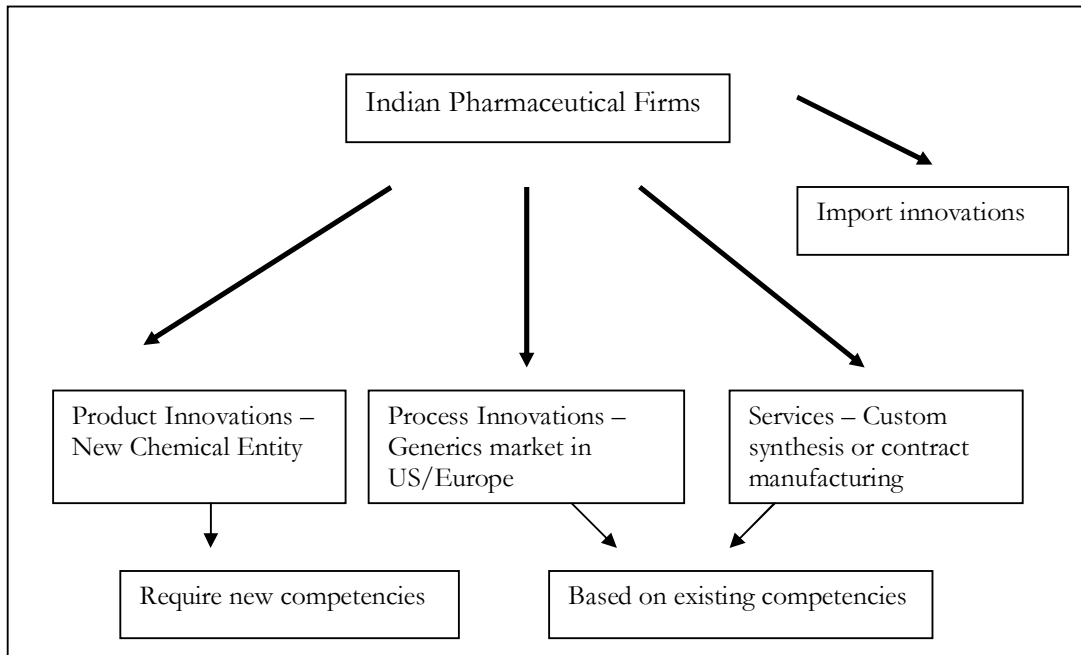


Fig. 3 Response of Indian firms to TRIPS challenge



Brief bio-data:

Dinar Kale holds an MSc in Organic Chemistry (University of Pune), an MBA in Marketing Management (University of Pune) and a PhD (The Open University Business School). Dinar has conducted significant research on evolution of capabilities in the Indian pharmaceutical industry, particularly impact of regulation on capability development, technology and innovation management in Indian pharmaceutical firms, and issues involved in organisational knowledge creation. His main research interests include the international business, knowledge development and technology and innovation management. His work has been published in the Technology Analysis and Strategic Management, Industry and Innovation and accepted for publication in Industrial and Corporate Change, British Journal of Management