Made in India for the World: An Empirical Investigation into Novelty and Nature of Innovations

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Abstract

After an initial introduction into the areas of innovations within emerging markets, the study develops a consistent innovation typology for categorizing large data samples from a variety of existing literature. It then describes and finally evaluates a sample of 178 innovations for the Indian market based on 38 different criteria. It uses internet-based news reports over a two year timeframe for the study sample.

The study's results show a considerable amount of radical innovations and innovations with disruptive potential among the sample and a special concentration on small- and micro-sized innovators from India. It confirms previous suggestions that India is especially focused on innovations within the software and electronics engineering sectors. The results also support the importance of local knowledge and 'social capital' for successful disruptive innovation. Finally, a perceivable increase in the technology orientation of innovations by foreign companies suggests a continuous build-up of local technology-competence and foreign trust in the same.

A focus on local competencies and the leading position of India concerning innovative distribution are among the managerial implication of the study. It also opens numerous avenues for future research, expanding both depth and scale of the database as well as the analysis underlying this study.

Keywords: frugal innovation, India, innovation typology, disruptive innovation, local competencies

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1. Introduction

For several years, there has been an increasing technology- and market-driven shift of innovation activities from established, developed markets towards emerging economies such as India (UNCTAD, 2005; Herstatt, Tiwari, Buse and Ernst, 2008; Kumar and Puranam, 2012; Gerybadze and Merk, 2014). Many large western companies establish R&D facilities in developing countries, realizing how quickly local educational standards are catching up to western structures and how quickly local markets grow at all levels of the economic pyramid. Nearly 70% of researching Fortune 500 companies conduct at least part of their R&D in India (Herstatt *et al*, 2008). With well above 2 million graduates a year, India and China are creating an impressive resource pool for further R&D investments (Knowledge@Wharton, 2005). At the same time, local markets are growing rapidly and multinationals begin to understand the potential of as yet untapped segments. C.K. Prahalad estimated the combined purchasing power at the "Bottom of the Pyramid"[3] to be roughly 3 trillion US$ p.a. (Prahalad and Hart, 2002). Countries like India also have a large and growing middle class (Ablett, Baijal, Beinhocker, Bose *et al*, 2007).

In this context, a special interest has arisen in innovations that not only thrive under the still restricted resource pools in developing markets but make special use of their 'frugality'. Concepts like "Gandhian", "Reverse" or "Frugal" Innovation are used to describe products and services specifically tailored to the needs of developing countries such as India or China and their mostly rural population (Immelt, Govindarajan and Trimble, 2009; Prahalad and Mashelkar, 2010; Sehgal, Dehoff and Panneer, 2010). C.K. Prahalad describes in his 2010 article 'Innovation's Holy Grail' how "affordability and sustainability replace abundance and premium pricing as drivers for Innovation" in developing countries (Prahalad and Mashelkar, 2010). Due to limited infrastructure, financial resources and education, the distribution, (interface-)design and cost-structure are of higher importance than in developed countries (Wooldridge, 2010). Instead of simply cutting costs and offering technologically outdated products from western markets at lower prices, true innovation in terms of technology and process are necessary in order to satisfy the demands of developing markets (Tiwari and Herstatt, 2012b). Stripping products of non-essential features and applying sophisticated technologies in order to reduce costs and adopt products to local environments makes the difference between failure and success of such innovations (Immelt *et al*, 2009; Sehgal *et al*,

[3] Part of the population with less than US$ 1,500 p.a. at purchasing power parity at their disposal; roughly 4 billion people worldwide (Prahalad and Hart 2002).

2010; Nakata, 2012). As a result, innovations developed under the severe constraints described above can result in out-of-the-box solutions that might not have been possible in more developed environments (Gibbert, Hoegl and Välikangas, 2007). Because of these special properties, some studies find promising potential in frugal innovations as lower-price alternatives for established markets (Tiwari and Herstatt, 2012b) as well as the seeds for disruptive innovation (Hart and Christensen, 2002), which may prove to the origin of industry-changing innovations (Christensen and Raynor, 2003).

While numerous case studies exist on frugal innovations in varying industries and their transfer potential (e.g. Immelt *et al*, 2009; Wooldridge, 2010; Tiwari and Herstatt, 2012a; b) there exists to the authors' knowledge little quantitative research on such innovations, their potential and their corporate and social context. Such research may help in better understanding the factors involved in successful frugal innovation and deliver an empirical basis to the alleged promise emerging nations are showing in this area.

This study aims at providing an initial quantitative evaluation of innovations being developed for an emerging market (India), by both local and foreign innovators. In order to do so, a database of 178 innovations has been created from online news-reports that were published between January 1st 2010 and December 31st 2011. The initial focus is put on three distinct areas, necessary to derive further additions to the data sample and meaningful research questions building upon this study and its database. They are:

1. What industry and company structures are the primary sources of innovation within an emerging market such as India?
2. Who (in terms of company origin) is the primary driver of innovation and where (in terms of R&D location) are innovations being developed?
3. What types of innovations arise from an emerging market such as India?

The paper is structured on the following lines: In order to consistently classify the recorded innovations, section 2 of this study develops an innovation typology based on existing literature on the subject. Section 3 then introduces the data sample and remaining criteria used for analysis and conducts the actual data evaluation. Section 4 concludes the paper with a discussion of the results, practical implications and avenues for future research.

2. Innovation Typology

In order do derive meaningful consequences from raw-data on individual innovations, these have to be categorized into consistently applicable sub-groups. The settings and chosen sources of this study require classification criteria that (a) enable the uniform, consistent categorization of large data samples with limited access to background information and (b) relate to the success of the innovation and the circumstances of its development (cf. Christensen and Raynor, 2003: 73). As Garcia and Calantone (2001) show, a variety of classification themes (typologies) of innovations are being used in current research applying similar terminologies (such as 'radical' or 'breakthrough' innovation) but differing definitions and classification criteria making an intuitive understanding and comparison difficult. In order to design the classification used for this study and future studies building upon its database as transparent and comparable as possible, the following sections draw upon the work of Garcia and Calantone (2001) as well as other widely accepted publications on innovation typology, such as the Olso Manual, in creating a transferrable innovation typology in accordance with the classification criteria.

2.1. Defining Innovation

One of the first comprehensive definitions of innovation has been created by Joseph A. Schumpeter in 1934, highlighting many of the aspects that are still considered to be the basis of modern understanding of innovations; among them the introduction of a new good or its quality, production method, new market, source of supply, or industrial organization (Schumpeter, 1934). In more recent times, strongly referencing Schumpeter and his seminal work, one of the most widely accepted definitions of the term innovation has been grafted by the Organization of Economic Co-operation and Development's (OECD) and Eurostat known as the "Olso Manual" (OECD and Eurostat, 2005) for collecting and interpreting innovation data:

> „An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations."

Due to its wide acceptance and application as well as its extensive documentation, this definition will be assumed and used throughout this study.

To be highlighted in this context is the aspect of the implementation, a mere concept or idea as such is not yet considered to be an innovation. Within this study only such cases are considered for the data sample that fulfil this basic definition of innovation.

2.2. Types of Innovations

The Oslo Manual identifies four distinct types of innovations (OECD and Eurostat, 2005). They are:

1. **Product Innovations:** involve significant changes in the capabilities of goods or services or the creation of completely new goods or services.
2. **Process Innovations:** represent significant changes in production and delivery methods.
3. **Organizational Innovations:** refer to the implementation of new organisational methods. These can be changes in business practices, in workplace organisation or in the firm's external relations.
4. **Marketing Innovations:** involve the implementation of new marketing methods. These can include changes in product design and packaging, in product promotion and placement, and in methods for pricing goods and services.

When implementing this framework it is important to notice that the four available types of innovation are not mutually exclusive for any given good or service. When introducing a new product to a market, this can (and often does) involve several types of innovation. The following example illustrates one such instance.

In 2010 a Chinese manufacturer introduced a new kind of ceramic tiles, made from the exhaust of coal power plants (Veach, 2010). The tiles are especially resistant to environmental influences. The manufacturing process had never been used before and therefore needs to be classified as a process innovation. At the same time, the special attributes of the tiles make them a product innovation in themselves.

Another difficulty can be the classification of marketing innovations vs. product innovations. In 2010, the Indian TV-Channel 'Zing' rebranded its entire identity, including channel-logo, colours and themes as a continuous ad for the product launch of a new toiletry product brand (Chakrabarty, 2010). This had never been done before and hence classifies as an innovation - but is it a marketing innovation by the toiletry brand 'Lux', or a product innovation by the Bollywood-channel 'Zing', whose business model is based on the sales of advertisement?

Since the responsible innovator, addressing his customers with a new channel, is the initiator (in this example 'Lux'), such cases are considered to be marketing innovations by the producing firm.

2.3. Degree of Novelty

Even though the degrees of Innovations (also degree of novelty or newness) is covered in the OECD's Oslo manual, Garcia and Calantone (2001) show in their thorough literature review on innovation typology how different interpretations and operationalizations of these concepts can lead to very different classification results. By introducing a comprehensive framework they offer a toolbox for grouping innovations by their degree of novelty using two levels of evaluation:

1. **The macro level:** evaluating the impact on an entire industry
2. **The micro level:** evaluating the impact on a particular firm

On both levels, the novelty/ discontinuity of the technology and of the market are evaluated on a yes/ no basis, thus reducing the classification of an innovation's novelty to several binary choices. This facilitates the individual assessment but requires additional information for each decision, as described in the following sections.

2.3.1. Newness of a Technology

Technology in this study's context is defined as extending beyond engineering and manufacturing. It is the process by which an organization transforms inputs such as capital, labour, materials and information into outputs (products and services) of greater value (Christensen, 1997).

The question to ask when assessing the newness of a technology to a firm (micro-level) is therefore: *"Has Company A used the same or a very similar technology earlier in order to provide a product or service to a customer?"* In addition, this question needs to be considered with respect to the type of innovation to be evaluated (product, process, marketing or organization). For marketing innovations for instance, the technology used for specific marketing purposes needs to be considered instead of the technology used in the actual product or service.

On the macro-level the according question to ask is: *"Has this or a very similar technology been used before by any company within the same industry?"* Important to note is the focus

on a specific industry, not the worldwide usage of a technology. (Garcia and Calantone, 2001) show that this distinction is reasonable for a useful classification framework, since innovations on a worldwide scale, with worldwide impact are extremely rare. As a consequence, the direct transfer of a technology from one industry to another is to be considered as a discontinuity on a macro-level.

2.3.2. Newness of a Market

Similar considerations are necessary for the market and marketing factors. First of all, a market is not to be understood in a regional sense. Launching an already established product, marketing method or organizational structure to the same customer segment in a new country does not imply new market/ marketing know-how. Instead, market is to be understood in the sense of a new customer segment that has new needs and/ or requires new access channels to be reached (Garcia and Calantone, 2001; Christensen and Raynor, 2003; OECD and Eurostat, 2005).

On a micro-level this implies the question: *"Has Company A addressed this or a very similar customer segment before?"* One might add *"with this or a very similar product"* since a company can address different needs of a customer segment with different products. Say, a company has been selling agricultural tools to farmers and now introduces information services on weather conditions and agricultural best-practices; this definitely involves new marketing know-how - even though the part of the population addressed is very similar. By entering a different industry (agricultural tools vs. information services), the company also changes its market segment. Note, that the marketing process involved in addressing a market segment plays no role in the evaluation of the newness of the market. A marketing innovation therefore does not necessarily imply a market/ marketing discontinuity on a micro- or macro-level.

On a macro-level the according question is: *"Has this or a very similar customer segment ever been addressed (by this industry)?"* Considering above mentioned example, a company that has been offering information services to farmers in developed countries and now (as the first company in the industry) starts offering these same services to rural farmers in India, introduces market discontinuities in both micro- and macro-levels, since needs and access channels of this new customer segment are very much different from the original segment. Therefore the move to a new regional market can also imply new market/ marketing know-how.

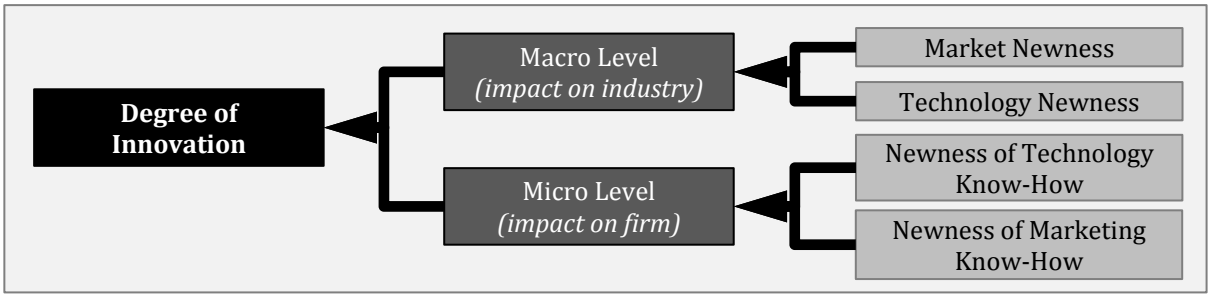

Figure 2-1 Framework 'Degree of Innovations'
(adapted from Garcia and Calantone, 2001)

By thus evaluating the four factors described above, innovations are placed into three distinct categories (Garcia and Calantone, 2001):

1. **Incremental Innovations:** can be defined as products that provide new features, benefits, or improvements to the existing technology in the existing market. They will only occur on the micro level.

2. **Really New Innovations:** are moderately innovative products. On a macro level, a really new product will result in a market discontinuity or a technological discontinuity but not both.

3. **Radical Innovations:** often do not address an existing demand but instead create a demand previously unrecognized by the consumer. They result in macro level discontinuities for both technology and market.

2.4. Disruptive Potential

In his 1997 book 'The Innovator's Dilemma', Harvard Professor Clayton Christensen introduced the notion that traditional innovation typologies do not serve as an adequate judge of the likelihood of success of the innovation. Neither do they provide reliable guidance for managerial action during innovation processes, according to Christensen (1997). He hence introduces an alternative variant of innovation typology titled *"principles of disruptive innovation (Christensen, 1997)"*.

These principles include two broad variants of innovations, namely

1. **Sustaining innovations:** improving the performance of established products according to the measurement criteria of their most important customers and

2. **Disruptive innovations:** generally underperforming existing technologies according to established performance criteria but introducing features valued by new or fringe markets.

Developed by start-ups or independent divisions and ripened in emerging market segments, disruptive innovations gradually become competitive in the initial markets and finally have the potential to fully substitute established technologies (Christensen, 1997). Disruptive innovations tend to be cheaper, simpler, smaller, or more convenient to use than established solutions (Christensen, 1997). This definition is similar to how (Tiwari and Herstatt, 2012b) define 'frugal innovation'. A connection between the two classes of innovations is possible and shall be investigated further.

In order to take into consideration the potential difference between more traditional typologies as described in section 2.3and Christensen's proposal, the above model is appended by two additional evaluation criteria. In 2003, Christensen and Raynor extended the model of disruptive innovations by subdividing disruptive innovation into *"new-market disruption"* and *"low-end disruption"* also providing simple-to-integrate litmus tests for checking specific innovations for their disruptive potential (Christensen and Raynor, 2003):

New-market disruption

- Is there a large population of people who have not had the money, equipment, or skill to do this thing for themselves, and as a result have gone without it altogether or have needed to pay someone with more expertise to do it for them?
- To use the product or service, do customers need to go to an inconvenient, centralized location?

Low-end disruption

- Are there customers at the low end of the market who would be happy to purchase a product with less (but good enough) performance if they could get it at a lower price?
- Can we create a business model that enables us to earn attractive profits at the discount prices required to win the business of these overserved customers at the low end?

The resulting process for checking an innovation's disruptive potential is depicted in Figure **2-2**. Accordingly, an innovation can have the potential to become a new-market disruption, a low-end disruption or both.

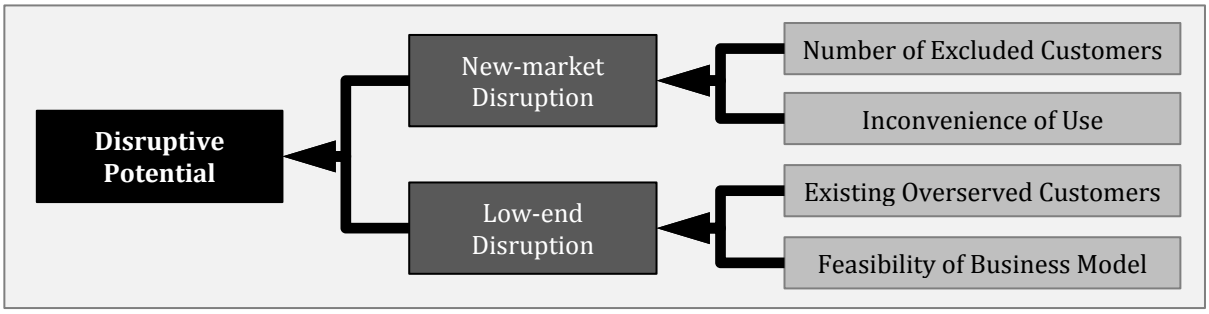

Figure 2-2 Framework 'Disruptive Potential'
adapted from (Christensen and Raynor, 2003)

2.5. Innovation Typology – Process approach

Combining the individual classifications described in the previous sections, a process for consistently classifying innovations has been derived and depicted in figure Figure 2-3. It will be applied throughout the following sections of this study.

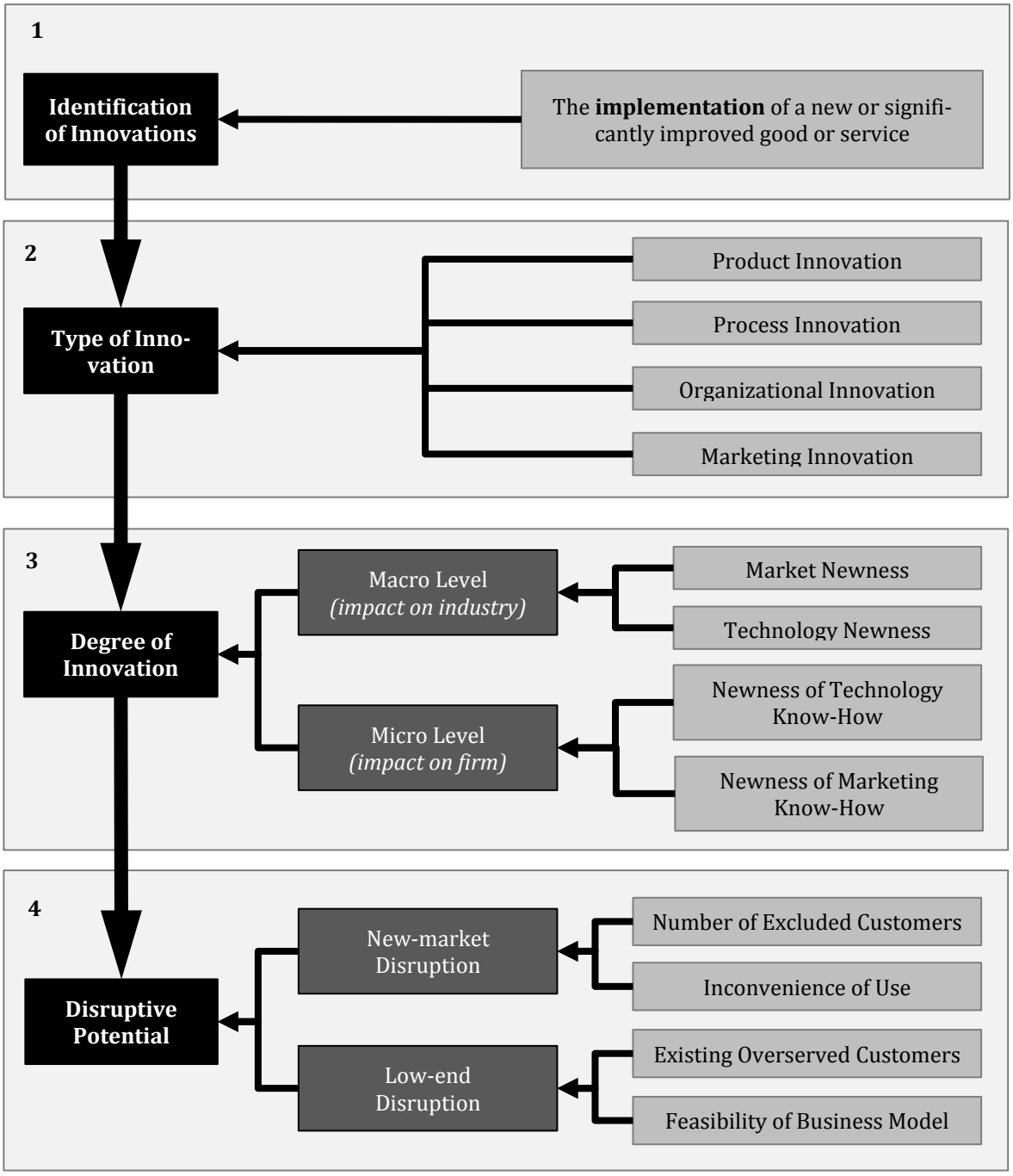

Figure 2-3 Process 'Classifying Innovations'

3. Empirical Study

3.1. Data Description

The online service 'Google Alerts' has been used to gather daily reports on several key words for this study. The key words were: 'India + Innovation', 'India + R&D', 'Offshoring + India' as well as their german translations 'Indien + Innovation', 'Indien + F&E', and 'Offshoring + Indien'. Across the study's timeframe between January 1st 2010 and December 31st 2011 this

query resulted in a total of well above 1.200 online-news reports that have been evaluated for references to innovations introduced in India. A total of 178 innovations have been identified. They were described in 69 individual publications primarily encompassing newspapers (such as Wall Street Journal and Times of India), innovation-oriented news portals (such as afaqs.com and siliconindia.com) as well as press archives (such as indiaPRwire.com and PR.com). The news reports were evenly spaced across the entire two-year time frame of the study. Wherever such data was available, the innovations have been catalogued according to the 38 criteria shown in Table 3-1. In order to properly classify the innovation itself, a typology as described in chapter 2 has been applied using criteria 19 through 29. Building upon these direct criteria, further aggregation and evaluation has been conducted as described in section 3.2ff. Additionally, company data has been recorded from publicly available data sources such as annual reports and press releases where available. The full dataset as been submitted with this study. An excerpt containing key criteria for all records is included in the appendix.

3.1.1. Innovator's Description

In order to investigate connections between the innovator's background, origin, and structure and the resulting innovations, several criteria relating to the innovating company or individual have been recorded.

General Information (criteria 1 – 8)

Apart from the innovator's name, his industry has been recorded according to the second revision of the European standard for statistical classification of economic activity in its second iteration (NACE v.2) (eurostat, 2008) with a detail of up to three levels. This facilitates a flexible aggregation of innovators into sub-sectors and their individual evaluation.

Innovator's description	1	Innovator's name	Describing the innovator
	2	NACE level 1	
	3	NACE level 2	
	4	NACE level 3	
	5	Origin (country)	
	6	Origin (classification)	
	7	R&D location (country)	
	8	R&D location (classification)	
	9	Revenues	Company classification
	10	No of employees	
	11	Year of foundation	
	12	Legal form	
	13	Company classification	
Innovation's description	14	Product name	General description
	15	Product category	
	16	Short description	
	17	B2C/ B2B	
	18	Innovative effect	
	19	Type of innovation	
	20	Market discontinuity	Degree of novelty
	21	Technology discontinuity	
	22	New market know-how	
	23	New technology know-how	
	24	Technology score	
	25	Market Score	
	26	Novelty	
	27	Potential new-market disruption	Disruptive potential
	28	Potential low-end disruption	
	29	Disruption result	
	30	Localization	Innovative effect
	31	Additional features/ performance	
	32	Lower cost	
	33	Simplified use	
	34	Easier availability	
	35	Other	
Other	36	Comment	
	37	Hyperlink	
	38	Date	

Table 3-1 Cataloguing criteria used for this study

Furthermore, the innovators' countries of origin have been recorded. The seat of a company's headquarters was considered to be decisive. In a very similar fashion, the country where a ma-

jor proportion of R&D related to the innovation in question has been conducted was included wherever possible. Since the differences and similarities between developed regions of the world (including Europe, North America, Japan, and Australia) and developing regions (with a focus on India) were of special interest to this study, an aggregation of both the innovators' countries of origin and their R&D locations has been conducted into these two categories.

Company Classification (criteria 9 – 13)

For relating innovative capacities and patterns to company size, a standardized classification scheme has been applied in accordance with the European Union's standard for business classification (eurostat, 2011). For a more uniform classification one additional range "very large" has been added above 10bn € in revenues or 10.000 employees. Companies and innovators have been assigned the next higher category as soon as one of the two criteria was fulfilled.

Class	Yearly revenues €[4]	No of employees
Micro		< 10
Small	< 1mn	10 - 49
Medium	1mn - 49mn	50 - 249
Large	50mn - 10bn	250 – 10.000
Very Large	> 10bn	> 10.000

Table 3-2 Company classification scheme in accordance with (eurostat, 2011)

In addition to a classification of company size, the legal form has been recorded as one of *public*, *private*, *NGO*, or *cooperative*. Where available, the year of the company's foundation has been included as well.

3.1.2. Innovation's Description

The following criteria include the innovation typology process developed in section 2 and complement it with specific product information, wherever such was available from the data sources.

General Information (criteria 14 – 17)

The general section encompasses the innovations' product name (where applicable) as well as a more general categorization and short description, giving the researcher a short impression of the kind of product/ service the innovation in question belongs to (The name could e.g. be '*ClimaCon'*, which is of the category 'a*pparel'* and has the description '*temperature regulat-*

[4] Based on average exchange rates over the fiscal year in question

ing clothes'). In addition, the target group has been identified as one of B2B or B2C, discerning end-consumers from business customers.

Innovative Effect (criteria 18 and 30 – 35)

Some studies attribute special importance to certain innovative effects (such as cost reduction) expected in above average quantities of innovations of certain typologies and origins (e.g. disruption and simplified usage (see Christensen, 1997) or innovations of Indian origin and reduced cost of ownership (see Tiwari and Herstatt, 2012a)). In order to inspect such correlations, every innovation in the dataset has been evaluated with respect to its innovative effect. The qualitative effect has been recorded in continuous text as mentioned in the sources. It has furthermore been classified into the following categories as described in several descriptive studies and reports (e.g. Utterback and Abernathy, 1975; Christensen, 1997; OECD and Eurostat, 2005; Tiwari and Herstatt, 2012b):

- **Additional features –** Existing functionality is extended and/ or supplemented. New functionality is added to the product or service.
- **Lower cost** – Life-cycle cost for the direct consumer is reduced. The origin can lie anywhere along the supply chain.
- **Simplified use** – The use of the product/ service has been simplified through interface design or modification of working principles.
- **Localization** – Existing or new functionality is adapted to special regional circumstances or tastes.
- **Easier availability** – Access to the product or service has been simplified. Access is provided to consumers previously excluded by limited technological, infrastructural or regional provisions.
- **Other**

Innovation Typology (criteria 19 – 29)

Type, degree of novelty and disruptive potential has been evaluated according to the process developed in section 2.

Other (criteria 36 – 38)

For each recorded innovation, the date of the according source-report has been recorded as well as the hyperlink of the source-report and additional comments. While the according hyperlink may not be available forever, each source-report has been separately documented and archived for future reference.

3.2. Data Evaluation

From the large variance of available evaluation criteria, three areas of primary interest have been chosen for this initial study.

In order to answer more detailed research questions in subsequent studies and prioritize future additions to the data sample, the focus for this initial study has been put on answering the tree questions

1. What types of innovations arise from an emerging market such as India?
   (covered in section 3.2.1),

2. Who (in terms of company origin) is the primary driver of innovation and where (in terms of R&D location) are innovations being developed?
   (covered in section 3.2.2),

3. What industry and company structures are the primary sources of innovation within an emerging market such as India?
   (covered in section 3.2.1).

3.2.1. Industry Distribution & Company Classification

Within the study's sample there is a strong concentration of innovations in the NACE level 1 industry clusters C (manufacturing, 60%) and J (information and communication, 34%). Furthermore, a majority of innovations belong to NACE level 2 clusters C26 (manufacture of computer, electronic and optical products, 20%) and J62 (computer programming, consultancy and related activities, 21%). This corresponds to existing studies, claiming that India has become a growing hub for software innovation and development of computers and electronics (Ernst, Dubiel, and Fischer, 2009; Vardi, 2010) as well as to recent data on telecom penetration (above 70%) and rising engineering exports (4.95b US$ to 68.8b US$ from '97 to '11) (RBI, 2011; TRAI, 2011). For a complete overview of industries represented within the sample see Figure 3-1, Figure 3-2 and corresponding supplementary legend in Table 3-3.

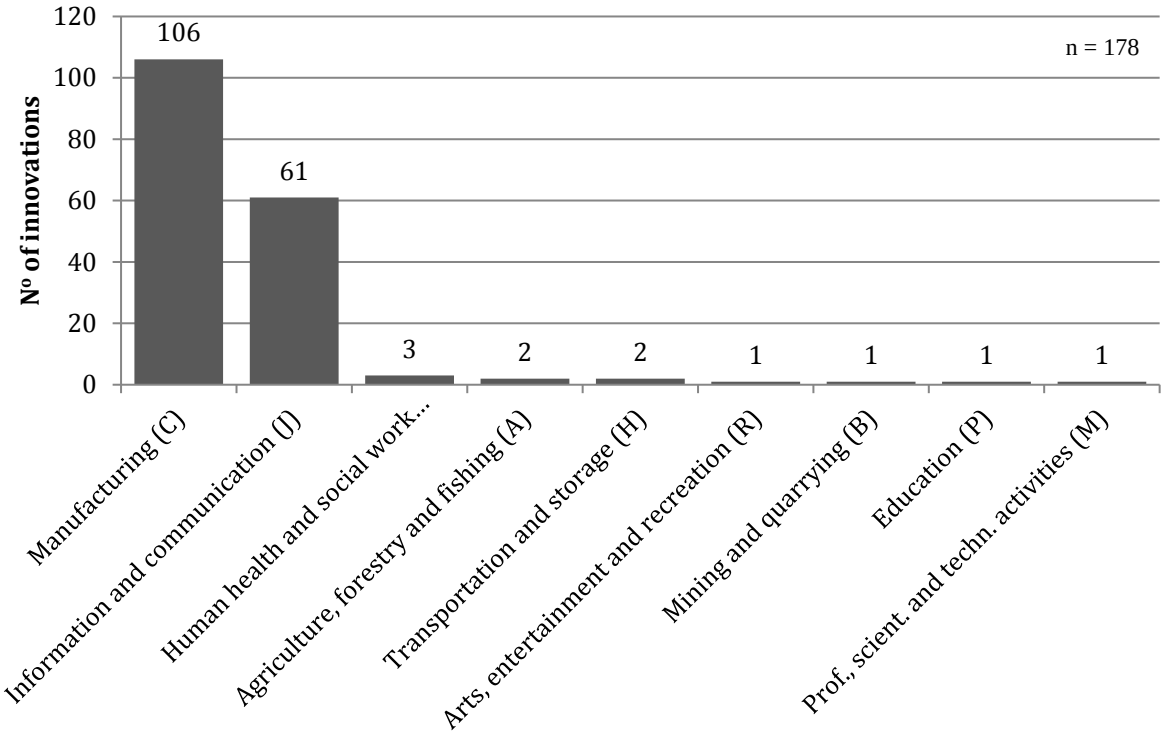

Figure 3-1 Number of innovations by NACE level 1 cluster

Accordingly, the top five industry clusters (NACE level 2) account for more than 62% of all innovations within the sample. Within these five clusters the distribution of innovative effects differs (as shown in Figure 3-3). While cluster 62 (programming etc.) has a large share of innovations with added functionality as well as increased availability, cluster 26 (manufacturing of electronics etc.) has a much larger share of innovations reducing cost. This may indicate the increased use of information technology and adapted software in supply chains distributed across rural environments, solving some of the inherent distribution challenges described by previous case studies (see e.g. Mahajan and Ramola, 1996; Gradl, Herrndorf, Knobloch, and Sengupta, 2010 for examples from the financial services sector). At the same time similar forces may be behind the focus on cost-reduction within the engineering sector, where the superb cost of highly engineered products until now hinders their widespread distribution.

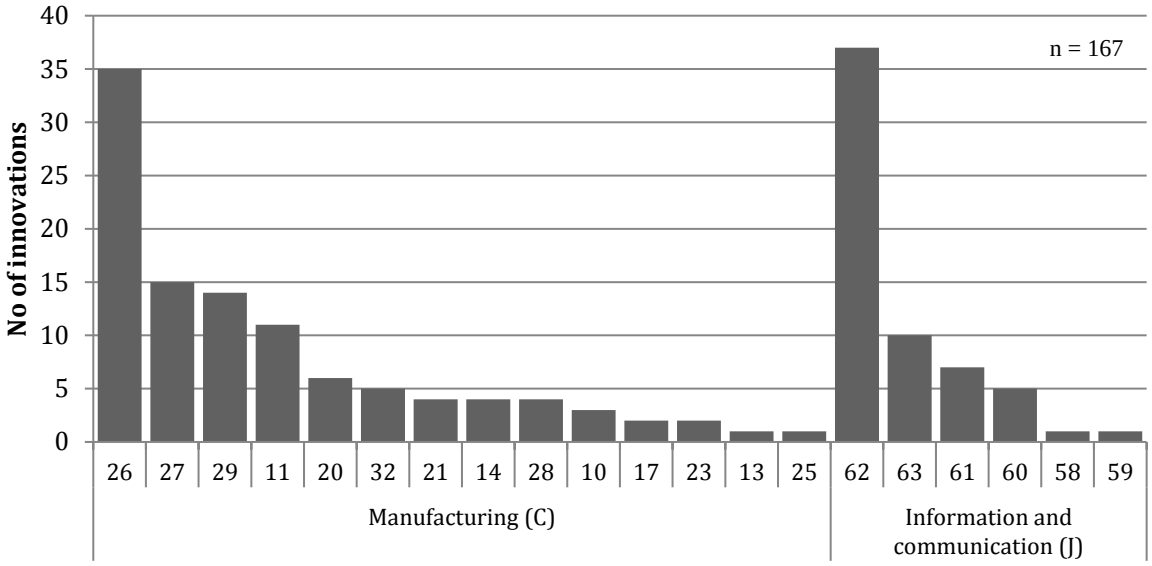

Figure 3-2 Number of innovations in NACE clusters C and J by NACE level 2 clusters
(for the legend see table 3-10)

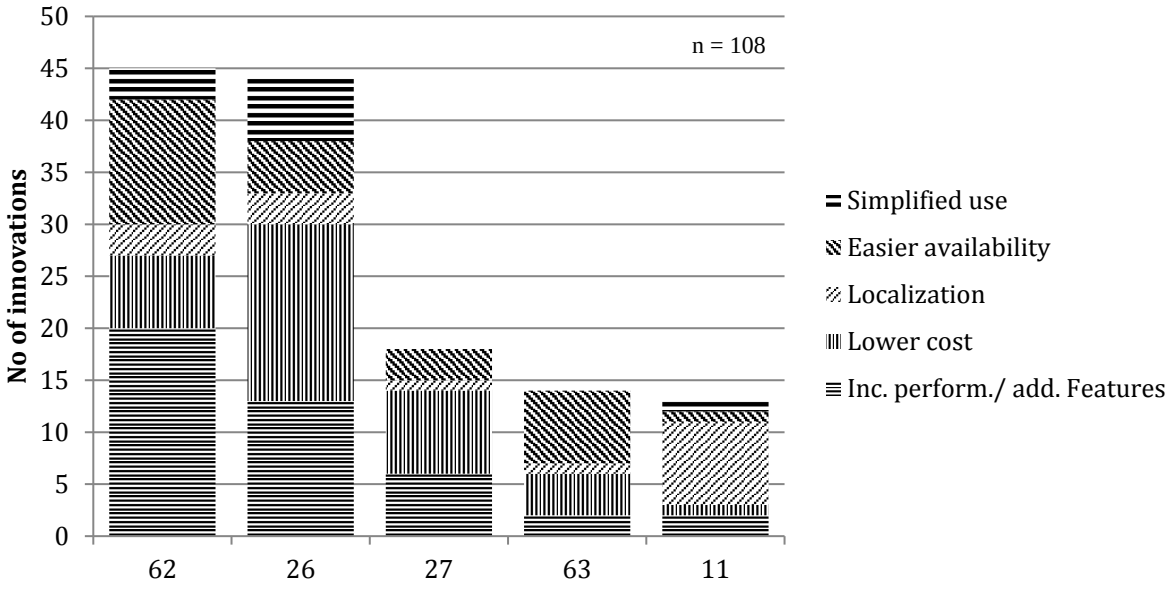

Figure 3-3 Number of innovations in TOP 5 NACE (L2) clusters by impact

C		Manufacturing
	10	Manufacture of food products
	11	Manufacture of beverages

	13	Manufacture of textiles
	14	Manufacture of wearing apparel
	17	Manufacture of paper and paper products
	20	Manufacture of chemicals and chemical products
	21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
	23	Manufacture of other non-metallic mineral products
	25	Manufacture of fabricated metal products, except machinery and equipment
	26	Manufacture of computer, electronic and optical products
	27	Manufacture of electrical equipment
	28	Manufacture of machinery and equipment n.e.c.
	29	Manufacture of motor vehicles, trailers and semi-trailers
	32	Other manufacturing
J		**Information and communication**
	58	Publishing activities
	59	Motion picture, video and television programme production, sound recording and music publishing activities
	60	Programming and broadcasting activities
	61	Telecommunications
	62	Computer programming, consultancy and related activities
	63	Information service activities

Table 3-3 Relevant excerpt from the NACE classification of industrial activity
(Based on: Eurostat, 2008, p. 55ff.)

Within the study's sample are 148 individual innovators. Eliminating direct corporate branches and similar associations leaves 141 individual companies and innovators. 51% of all innovators fall into the category 'very large' or 'large' which together account for 63% of all innovations. When considering the total number of innovations, these two categories are also the most innovative measured in number of innovations per company – as is to be expected considering the significant difference in workforce and financial resources involved in the classification scheme (see Figure 3-4).

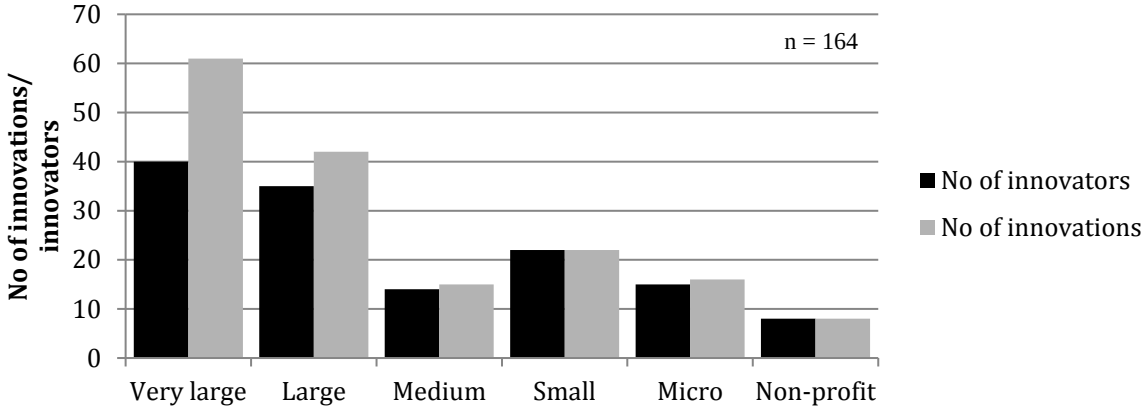

Figure 3-4 Number of companies and innovations by company size in sample

However, a further examination of the disruptive potential and degree of novelty of the innovations reveals that the difference in the absolute number of potentially disruptive innovations

is much smaller across company sizes than for incremental and sustaining innovations. Hence the *relative* number of radical and disruptive innovations is much higher for the smaller company sizes (e.g. in the extreme: 0,44 radical innovations per micro-innovator vs. 0,08 per very large-innovator; see Figure 3-5 and Figure 3-6 for details). This supports the claim that potentially disruptive and/ or radical innovations flourish more easily within smaller organizations (Christensen and Raynor, 2003). It thereby also suggests that start-ups and grassroot innovators (31 within the sample, all local in origin) account for a relatively large portion of these innovations, highlighting their importance for the innovation climate in an emerging market such as India. Consequently, scholars arguing for the importance of social capital and knowledge of local conduct in the frugal innovation process (e.g. Subramaniam and Youndt, 2005; Tiwari and Herstatt, 2012b) may find support in this result.

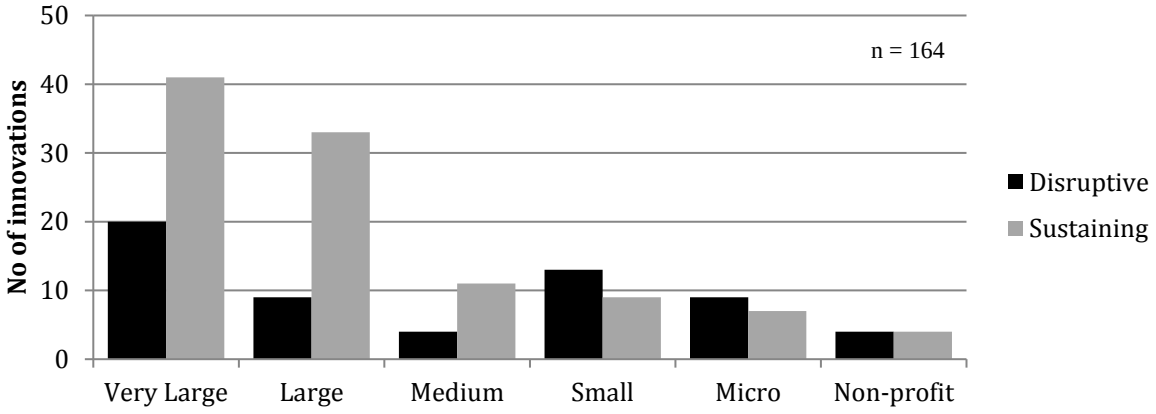

Figure 3-5 Number of innovations by disruptive potential and company size

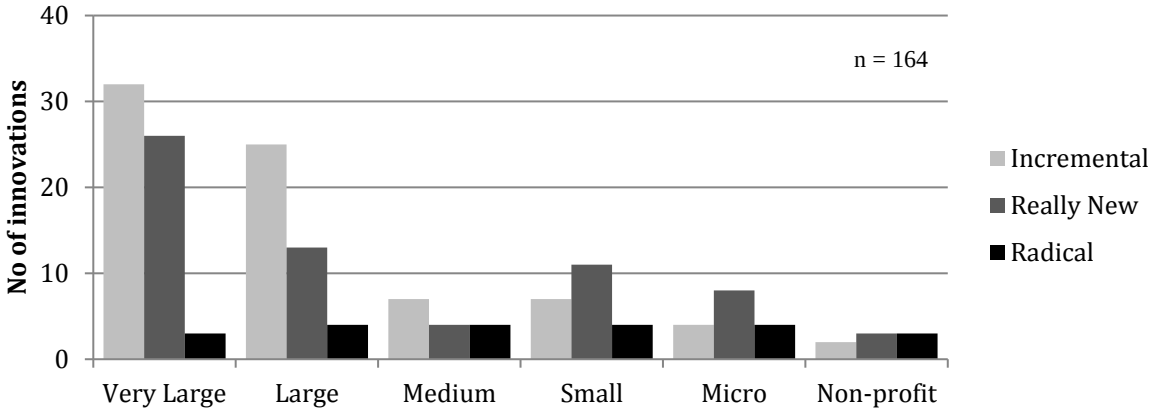

Figure 3-6 Number of innovations by degree of novelty and company size

3.2.2. Influence of Innovator's Origin and R&D Location

Within the given sample a majority of innovations (71%) stem from Indian innovators and have been developed within India. A second large block (21%) originates in companies from the developed world but has also been developed in India. Table 3-4 shows an overview of the number of innovations within the sample by their innovator's origin and their R&D location.

		R&D location			
		Developed World	India	RoW	**Grand Total**
Innovator's origin	Developed World	7 *(4%)*	35 *(21%)*	0 *(0%)*	**42** *(25%)*
	India	2 *(1%)*	117 *(71%)*	0 *(0%)*	**119** *(72%)*
	RoW	0 *(0%)*	1 *(1%)*	3 *(2%)*	**4** *(2%)*
	Grand Total	**9** ***(5%)***	**153** *(93%)*	**3** *(2%)*	**165** ***(100%)***

Table 3-4 Number and share of innovations in sample by innovator's origin and R&D location

When looking at the timeline of innovations (shown in **Figure 3-7**) and their share by country of origin, the average share of Innovations by Indian companies increases slightly over the 24 month timeframe of the study.

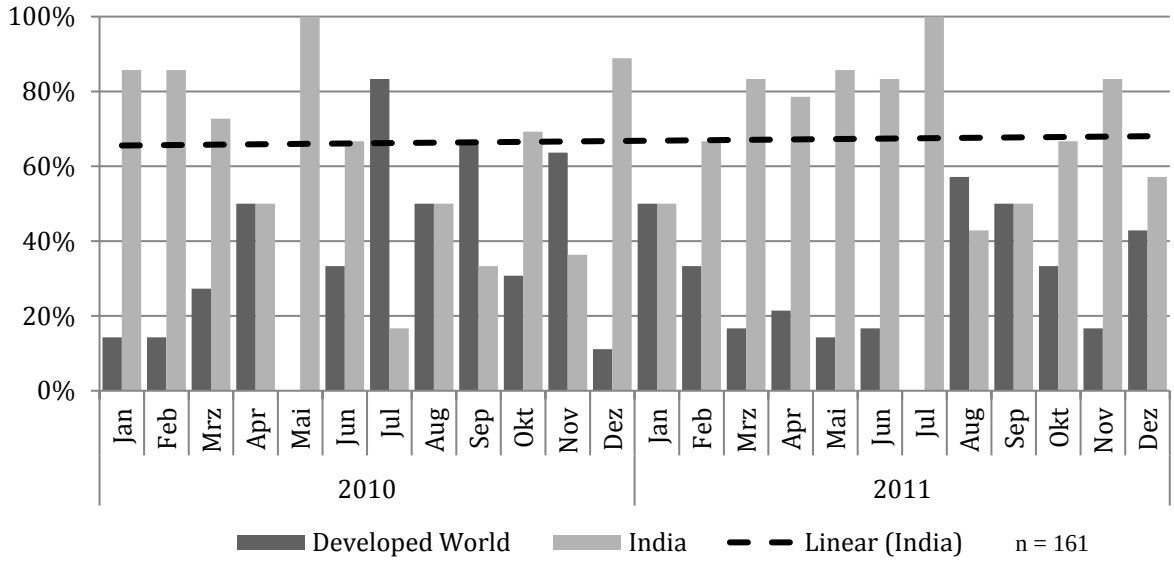

Figure 3-7 Timeline of the share of innovations by the innovator's origin[5]

[5] For reasons of simplicity only India and developed world are shown in the figure. The four innovations originating in the rest of the world (RoW) have been omitted. Due to their wide spread across the depicted timeframe, they do not change its appearance perceptibly.

Table 3-5 and Table 3-6 show the distribution of the degree of novelty by R&D location for Indian innovators and those from developed countries, respectively. While the share of really new innovations developed in India is much larger for innovators from the developed world (50%) than for Indian innovators (34%), the reverse is true for radical innovations that make up a share of 17% of all innovations by Indian companies and entrepreneurs but only 2% of those by companies from developed countries.

		Degree of novelty			
R&D location		Incremental	Really new	Radical	**Grand total**
	Developed world	2 *(2%)*	0 *(0%)*	0 *(0%)*	2 *(2%)*
	India	56 *(47%)*	41 *(34%)*	20 *(17%)*	117 *(98%)*
	Grand total	**58** *(49%)*	**41** *(34%)*	**20** *(17%)*	**119** *(100%)*

Table 3-5 Number and share of innovations by Indian companies by their R&D location and degree of novelty

		Degree of novelty			
R&D location		Incremental	Really New	Radical	**Grand Total**
	Developed world	1 *(2%)*	5 *(12%)*	1 *(2%)*	7 *(17%)*
	India	13 *(31%)*	21 *(50%)*	1 *(2%)*	35 *(83%)*
	Grand Total	**14** *(33%)*	**26** *(62%)*	**2** *(5%)*	**42** *(100%)*

Table 3-6 Number and share of innovations by companies from developed countries by their R&D location and degree of novelty

In order to gain a deeper understanding of the kind of innovations developed within the sample, Table 3-7 and Table 3-8 evaluate the technology score of the innovations in a similar fashion as above. This evaluation reveals, that the share of high-technology innovation (causing a technology discontinuity on a macro level) of innovations developed within India is more than twice as high (46%) for Indian innovators as it is for their counterparts from the developed world (19%). This result could be an indication that, while companies from developed countries continue to expand their R&D facilities within the emerging markets, their most sophisticated technology oriented R&D is still conducted elsewhere, presumably within their home-markets. At the same time, Indian companies concentrate also their most advanced technology development in India.

R&D location		*Technology score*			
		0	1	2	**Grand total**
	Developed world	0 *(0%)*	2 *(2%)*	0 *(0%)*	2 *(2%)*
	India	25 *(21%)*	37 *(31%)*	55 *(46%)*	117 *(98%)*
	Grand total	**25** *(21%)*	**39** *(33%)*	**55** *(46%)*	**119** *(100%)*

Table 3-7 Number and share of innovations by Indian companies by their technology score and R&D location

R&D location		*Technology score*			
		0	1	2	**Grand total**
	Developed world	3 *(8%)*	0 *(0%)*	4 *(10%)*	7 *(17%)*
	India	18 *(43%)*	9 *(21%)*	8 *(19%)*	35 *(83%)*
	Grand total	**21** *(50%)*	**9** *(21%)*	**12** *(29%)*	**42** *(100%)*

Table 3-8 Number and share of innovations by companies from developed countries by their technology score and R&D location

This observation poses the question of the development of technology oriented innovations in India over time, i.e. has foreign innovators' trust in technology oriented R&D within India risen over the past years. As several current studies (see Herstatt *et al*, 2008) suggest, the average technology score of innovations by companies from developed countries has risen considerably across the study's timeframe, pointing towards increased availability of according infrastructure and technology distribution as well as increased outsourcing activities in technology oriented areas (e.g. Tiwari and Herstatt, 2012a). However, the average technology score of innovations by Indian innovators has decreased slightly, very much in contrast to the studies and suggested trends mentioned above. This poses the question, whether there is an actual decrease in technology oriented innovation underlying this apparent tendency or whether an above average increase in less technology heavy innovation causes the phenomenon (see Figure 3-8).

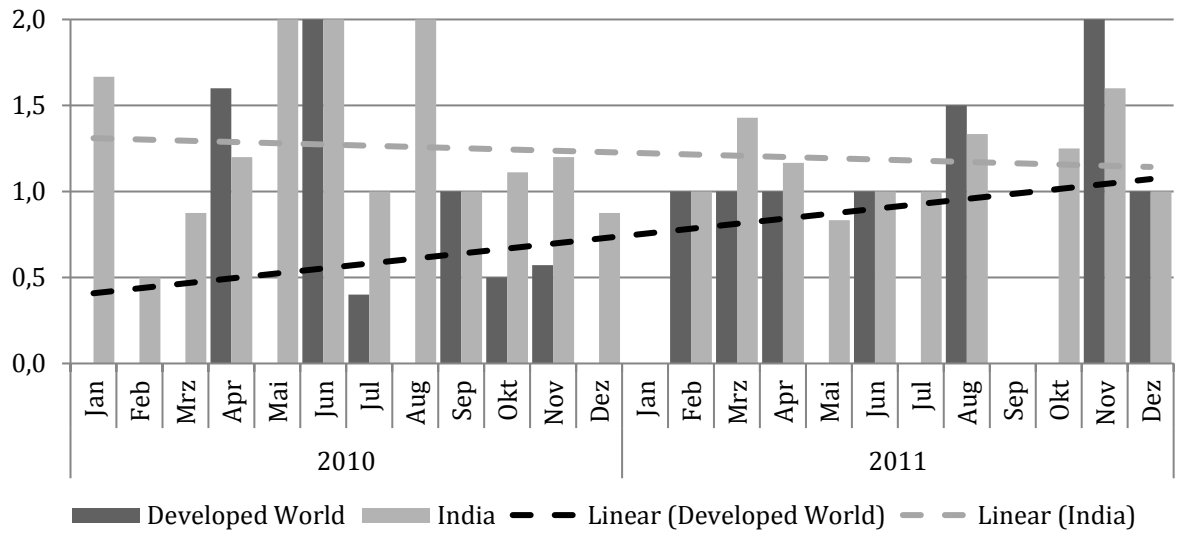

Figure 3-8 Average technology score by innovator's origin

Indeed, Figure 3-9 shows a slight increase in innovations with technology score 2 by Indian innovators. The overall decrease in the average technology score is caused by a decrease in innovations with a technology score of 1 (technology discontinuity on a micro-level). In essence, this may imply the move from innovations that are merely technologically new on a micro-level, towards more globally revolutionary R&D conducted by Indian innovators.

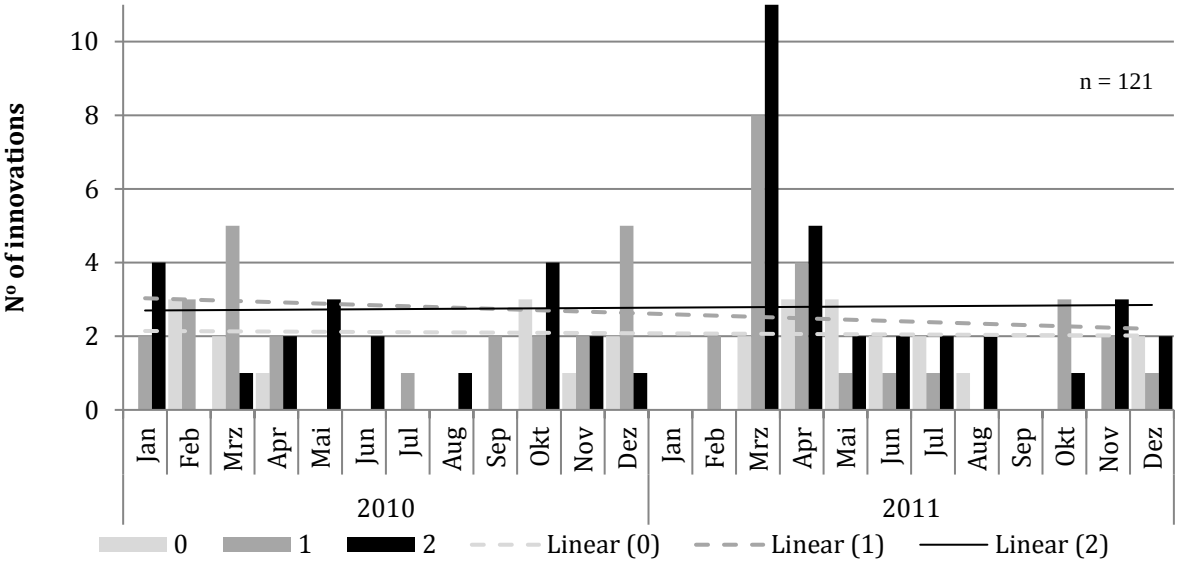

Figure 3-9 Timeline: number of innovations by Indian companies by their technology score[6]

Finally, the number and share of innovations with disruptive potential varies only slightly between Indian innovators (34%) and those from developed countries (45%) as shown in Table 3-9 and Table 3-10. This may be an indication that the unique circumstances within emerging

[6] The considerable spike in Mach 2011 results from in-depth media coverage of a nation-wide Indian innovation contest conducted by the National Association of Software and Services Companies (NASSCOM).

economies resulting in a special composition of innovations apply similarly to indigenous and foreign innovators. However, the influence of 'social capital' in the emergence of innovations tailored to emerging markets (see Subramaniam and Youndt, 2005) needs to be further investigated.

		Disruptive potential		
R&D location		Yes	No	**Grand total**
	Developed world	0 *(0%)*	2 *(2%)*	2 *(2%)*
	India	40 *(34%)*	77 *(65%)*	117 *(98%)*
	Grand total	**40** *(34%)*	**79** *(66%)*	**119** *(100%)*

Table 3-9 Number and share of innovations by Indian companies by R&D location and disruptive potential

		Disruptive potential		
R&D location		Yes	No	**Grand total**
	Developed world	4 *(10%)*	3 *(7%)*	7 *(17%)*
	India	15 *(36%)*	20 *(48%)*	35 *(83%)*
	Grand total	**19** *(45%)*	**23** *(55%)*	**42** *(100%)*

Table 3-10 Number an share of innovations by companies from developed countries by R&D location and disruptive potential

3.2.3. Innovation Typology

Of the 178 innovations within the sample, 83 (47%) have been rated as incremental innovations. Accordingly, just under half of all recorded innovations happen solely on the micro-level and hence require the firm to develop new technology- and/ or marketing-know-how that has already been applied by competitors within the same industry.

72 innovations require the innovator to apply either technological or marketing skills that have never been implemented within the same industry before and finally 23 (13%) of all innovations within the sample classify as being radical in the sense that they require the innovator to apply both market-know-how and technology-know-how that hasn't been used within his industry before (see Figure 3-10). Considering how previous studies have described radical innovation as rare, and, when successful, game-changing within their industry (e.g.

Chandy and Tellis, 2000; Hill and Rothaermel, 2003), this number is to be considered quite substantial.

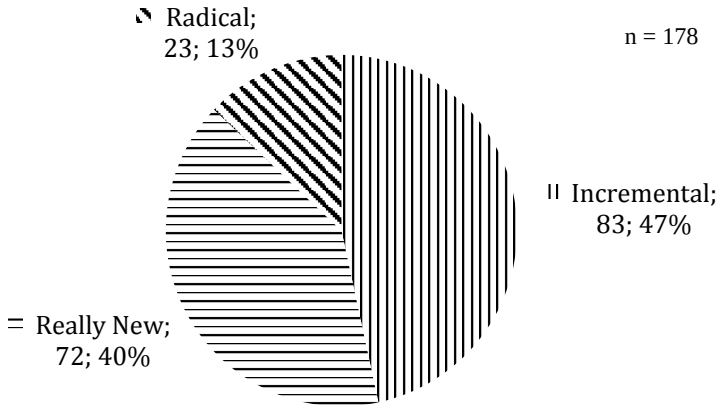

Figure 3-10 Number of innovations in sample by their newness

Figure 3-11 shows the distribution of the innovations' disruptive potential according to the criteria described in section 2.4. While 116 (65%) of the sample carry no disruptive potential and can therefore be classified as 'sustaining' innovations, 62 (35%) have the potential to be shaped into a disruptive innovation in the sense of (Christensen, 1997) and (Christensen and Raynor, 2003). Closer inspection shows that among the third of the sample having disruptive potential, the largest group of 29 innovations (16%) has some potential for being shaped into a new-market disruption, extending a product or service into parts of the population excluded by previous offers, while a somewhat smaller group of 17 innovations (10%) have potential to become low-end disruptions in markets where previous customers have been overserved by existing alternatives. 16 innovations combine both kinds of disruptive potential.

When combining both evaluations (degree of novelty and disruptive potential, as shown in Figure 3-12), the overall picture is confirming initial expectations. All 23 innovations classified as radical also have potential to become disruptive innovations. Among the really new category only 34 (close to 50%) of innovations have disruptive potential, while the rest (38) are of purely sustaining character. A large majority (78 of 83) of incremental innovations have no disruptive potential. However, the five remaining innovations have potential to be shaped into low-end disruptions. While this combination may seem unlikely, (Christensen and Raynor, 2003) describe how incremental und sustaining are not mutually enforcing classifications. The cases included in this study encompass innovations that lower the price of the product/ service to the consumer while utilizing established technology in functionally simplified solutions. Among them is for example an e-book reader using standardized, well estab-

lished components and drastically simplified functionality in order to reduce its price to around 40% of its largest competitors. While the product in question does not apply technology- or market-know-how that is in any way new to the industry, its value proposition may be shaped into a product serving established customers who are presently overserved by the functionality of existing e-book readers and willing to accept a less functional product at a significantly lower price.

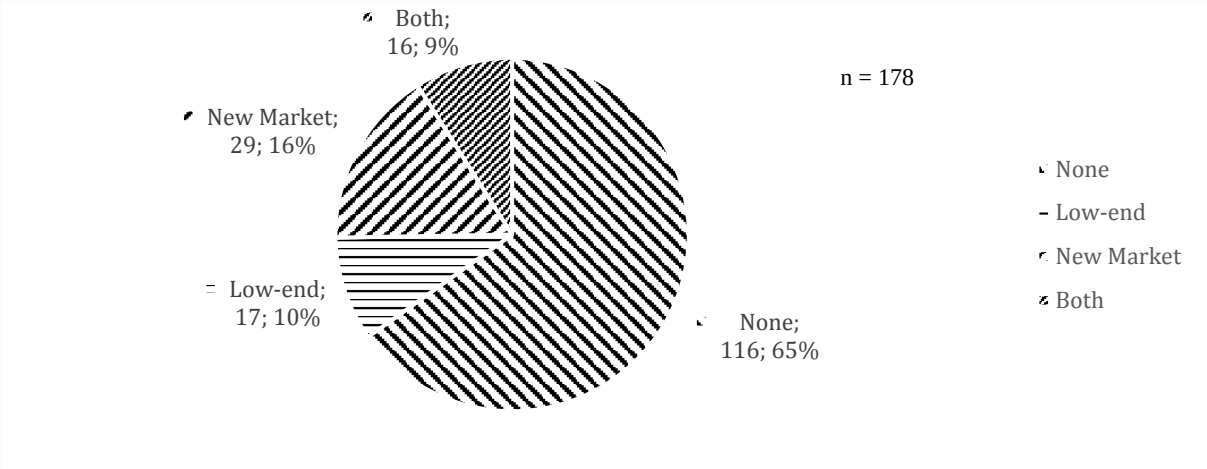

Figure 3-11 Number of innovations in sample by their disruptive potential

The match between the degree of novelty and disruptive potential of the innovations within the sample suggests that, even though individual innovations might diverge as exceptions, both classifications describe the innovative potential of an innovation along similar lines. While both classifications certainly contribute to the understanding of an innovations potential, this result somewhat contradicts the presumption that 'traditional' classifications oriented along the degree of novelty fail to adequately classify an innovations character (Christensen and Raynor, 2003).

An additional result emerging from the present data-analysis is the direct correlation of the definitions for a market-discontinuity on a macro (industry) level and potential new-market disruptions. Whenever an innovation involves a market-discontinuity on a macro-level as described in section 2.3.2the innovator addresses a customer segment that by definition has never had access to the product or service being offered. Especially, but not exclusively, when the innovator's industry is already well established in other market-segments, this by itself fulfills a potential new-market disruption as described in section 2.4Vice-versa, any innovation fulfilling the criteria for a potential new-market disruption must by definition involve a market-discontinuity on a macro-level – otherwise the new customer segment would have had access to the product or service before.

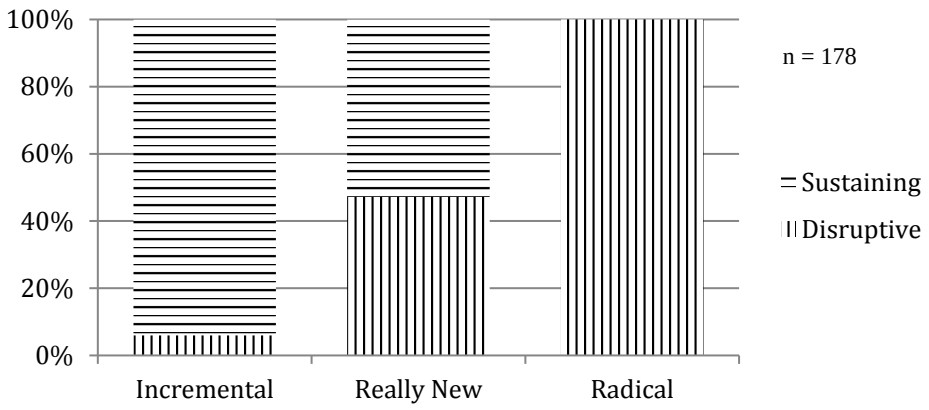

Figure 3-12 Share and number of innovations by degree of novelty and disruptive potential

A large group of 143 (80%) of all innovations within the sample are product innovations, followed by marketing (19, 11%), process (13, 7%) and organizational (3, 2%) innovations (see Figure 3-13). As publicly available news reports were used as the primary source for this sample, a connection between the choice of sources and the large share of product innovation in the sample is possible as a consequence of the high media attention focused on the launch of innovative products compared to company-internal changes inherent to organizational innovation. Across all types of innovations, the share of incremental, really new and radical innovations is comparable (Figure 3-13). Due to the small sample-sizes in all but product innovations, these results would have to be validated using an additional data source, possibly more focused on firm-internal innovation.

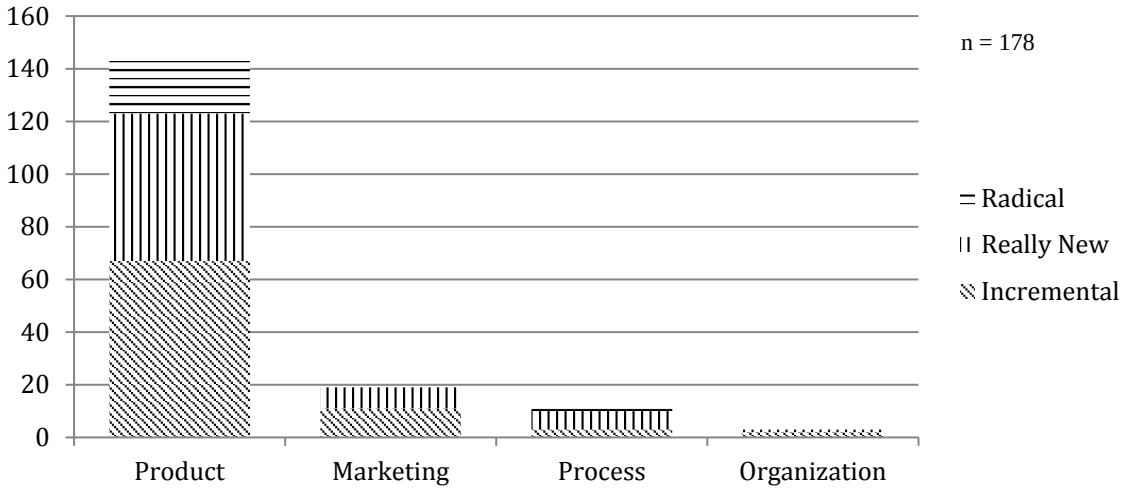

Figure 3-13 Number of innovations in sample by their type and newness

Corresponding to the majorities of incremental and sustaining innovations, a large number within the sample (70, 47%) encompasses additional product features in their innovative effect. This is in turn followed by innovations lowering product cost (57, 30%) and innovations

increasing availability (41, 23%). When subdividing the sample into its sustaining and potentially disruptive subgroups (as shown in Figure 3-14), the innovative effects split as predicted by literature (Christensen and Raynor, 2003). While more than half of all sustaining innovations involve additional product features and thereby put a focus on increased versatility, less than 10% of innovations with disruptive potential involve such additional functionality. Instead, they are dominated by reduced cost and increased availability. There is no discernible difference in the share of localizations and innovations simplifying product use between the sustaining and disruptive subgroups.

Some studies (e.g. Hart and Christensen, 2002; Lee, Lin, Wong and Calantone, 2011) have suggested that simplified usage is of primary importance in order to ensure swift adoption of new products within developing markets. While some of the innovations within the sample do include simplification, it is the rarest of the innovative effects recorded. (Tiwari and Herstatt, 2012b) describe innovations emerging from India as being characterized by *"their affordability, robustness and 'good enough' quality"*. The considerable share of potentially disruptive innovations and innovations introducing reduced costs seem to confirm the affordability and 'good enough' quality of the products and services within the study's sample. The results also suggest that robustness may just be a necessary precondition for enabling easier distribution and availability of innovations in rural environments where infrastructure and population are stretched thinly across vast regions.

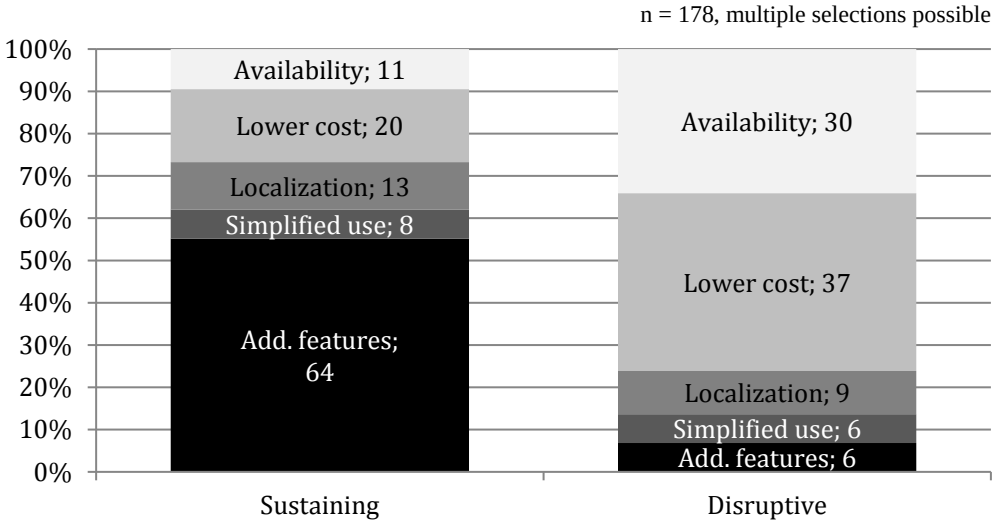

Figure 3-14 Share of impacts of innovations by disruptive potential

4. Conclusions and Implications

This study built a database of 178 innovations by more than 140 individual innovators from a basis of 1.200 news reports. The innovations were classified by a variety of criteria derived from current literature and an initial evaluation of the results has been conducted. The following sections discuss the methods and sources used for this study and its initial results. Possible practical implications as well as avenues for future research will be examined.

4.1. Discussion

The evaluations conducted in section 3.2.1showed a considerable share of radical innovations and such with disruptive potential (both low-end and new-market) among the study sample. This finding very much agrees with past statements that India is in the process of establishing itself as a hub for disruptive innovation (Bellman, Misquitta and Glader, 2009; Prahalad and Mashelkar, 2010) and the interconnectedness between disruptiveness and frugality (Hart and Christensen, 2002; Tiwari and Herstatt, 2012a).

The distribution of innovative effects among the evaluated innovations confirms the importance of reduced costs for potentially disruptive innovations (e.g. Christensen, 1997) and also highlights a large share of innovations increasing the availability of a product or service among those with disruptive potential. As numerous case studies have shown, the rural Indian environment poses significant challenges to traditional distribution networks and supply chains both in the product and service sectors (Immelt *et al*, 2009; Gradl *et al*, 2010; Wooldridge, 2010). As these challenges, among others comprised of widespread population, little infrastructure and low levels of literacy and education, and low amounts of daily per capita income (Prahalad and Hart, 2002), have seldom been part of the innovation process of products and services from the developed world, they create a number of difficulties for companies trying to transfer their innovations into the emerging market. Hence, innovations adapting traditional solutions from the developed world often encompass ways to simplify access and distribution. For similar reasons, data-infrastructure and telecommunications (that reduce the dependence on heavy infrastructure such as power grids, land lines etc.) are among the most strongly represented industries within the sample. While the tendency of India developing towards a hub for software and electronics has been recognized before (e.g. Ernst *et al*, 2009; Vardi, 2010), this finding further justifies this development towards an Indian leadership in widespread, cheap access channels (be they digital or not).

A considerably higher share of radical innovations by innovators from India compared to innovators from the developed world (section 3.2.2(similar numbers for innovations with disruptive potential) support the importance of 'social capital' and knowledge of local customs and environments as an important factor in the successful development of innovations tailored for an emerging market, as other studies have suggested on a case and theory basis (Subramaniam and Youndt, 2005; Tiwari and Herstatt, 2012a). The findings of section 3.2.1contribute to this a much higher share of radical and disruptive innovations for small and micro-innovators, giving credit to a) Christensen and Raynor's (2003) claim that such innovations thrive better within smaller organizational units and start-ups and b) supporting the connection between frugality and disruption, as small and especially micro-enterprises are expected to make more use of 'good enough'/ frugal technologies and choosing unestablished solutions for their innovations (Hart and Christensen, 2002; Prahalad and Mashelkar, 2010). Combined, these findings also provide credit to emerging theories talking about India as a possible 'Lead Market' for frugal innovation (Tiwari and Herstatt, 2012a; b).

Additionally, the strong increase in technology orientation for innovations by companies from developed countries suggests a rising availability as well as trust in local resources and know-how.

Beyond the results from the actual data evaluation, the process for categorizing innovations according to a consistent typology developed in section 2 of this paper can easily be applied for other innovation studies and thereby contributes the literature on innovation studies and their comparison. The application of this process on the study's data sample yielded additional insights into the relation of different innovation classification schemes (such as disruption vs. novelty), further simplifying future studies.

4.2. Practical & Managerial Implications

The findings presented in this study have several implications for firms innovating in the context of emerging markets and especially India. When aiming for radical and/ or disruptive innovations that may be transferrable to developed markets, India's natural conditions favor innovative distribution channels, high product and service availability, and low life-cycle cost. Hence these are areas best developed within the emerging market, using local knowledge. Additionally, the use of small organizational sizes for such innovations seems preferable.

As the amount of technology oriented innovation from India as well as for the Indian market (especially by innovators from developed countries) increases noticeably over the timeframe

of inspection, traditional reservations against building technology hubs within emerging markets seem to shrink for established players, thereby further increasing the viability of localized R&D within emerging markets.

4.3. Implications for Further Research

The sources used for this study are all internet-based news reports. An influence of this choice on the resulting spectrum of innovations through uneven coverage of the innovative landscape and focused PR-campaigns of major firms cannot be ruled out. However, these effects may well be countermanded by focused grassroot-networks and innovation prizes, making up a significant portion of the sample.

The scope of this study allowed for the chosen two-year timeframe. While this yielded a sufficiently large number of innovations to deduce clusters, timelines are still heavily influenced by spikes and outliers introduced through tournaments, prizes and in-depth media coverage of single events. Accordingly, regressional analyses and statistical significance testing are among the analysis methods suggested for future research projects.

Building upon the results of this study as well as its above mentioned limitations, several extensions and more specific avenues for further research are suggested. For once, the timeframe and depth of analysis can be extended consistently by using the criteria described in this paper. By covering a greater timespan and increasing the number of innovations, the results, especially for timeline evaluations, can be improved and made less vulnerable to outliers and spikes in the data. Such an extension of the study would also permit the evaluation of policy changes on innovation activity – changes that would not be visible within the present timelines.

By extending not the number of cases in the sample but the evaluation criteria, additional influences on the success of innovations may be gained. Promising criteria for such extensions are the innovations' target population (rural/ urban, rich/ poor) and the requirement of social capital in order to implement any given innovation. These two criteria might deliver meaningful insight into the possibilities of foreign innovators to develop solutions for local markets with or without local involvement in the R&D process.

Finally, a comparison of the results with similar data from other emerging markets (e.g. China, Russia, South America) would yield a valuable distinction between factors typical for the individual market and results generally applicable to emerging economies and their innovation

systems. Similar results could be achieved by gathering a comparable sample of innovations from developed countries in order to better contrast the different shares of innovation types against each other.

Extending the database in one or several of the above directions should also permit the use of more in-depth statistical analysis such as regressions and significance testing.

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