Technologie- und Innovationsmanagement

W o r k i n g P a p e r

Consumer Innovation in the *poor* versus *rich* world –

Some Differences and Similarities

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May, 2012
Working paper No. 71

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Abstract

Innovative, distinct products and no "cheaper" copies of the "rich" world are essential in order to succeed at the "Base of the Pyramid" (BoP). However, this type of innovation requires more, in-depth information on the BoP and solution spaces, which are both difficult to access. Literature proposes to generate innovations bottom up through user involvement but remains silent on how to identify and integrate BoP consumers into the innovation process. One obvious solution is to connect up with and cooperate with innovating consumers of the BoP. However, this raises the questions whether 1) user innovation exists at the BoP at what levels of quality and 2) how firms can support the innovators to implement them into real world solutions. In this paper we specifically address the first question and analyze patterns and characteristics of a large sample of innovations developed by people living at the Indian BoP collected by the Indian National Innovation Foundation (NIF). We compare these innovations to consumer innovations in the developed world and examine effects of demographic, knowledge and context factors on innovation activity and the outcome. We find similarities with consumer innovation in the developed world and at the same time adaptations to the BoP context, e.g. fulfillment of rather basic necessities than hobby-related needs. Innovation quality is mostly driven by the innovator's knowledge and market recognition is highest for creative innovations developed for others. The paper further shows that consumer innovations are a good starting point for firms seeking solutions for BoP markets. Product needs can be systematically deducted and provide insights on how to identify promising consumer innovators at the BoP. Finally, this research contributes to better understand user innovation behavior in a specific context and by that enriches innovation research.

1. Introduction

Approximately one billion poor people are living at the global base of the income pyramid across various developing and underdeveloped countries (Prahalad, Hart 2002). Their combined purchasing power of more than a billion USD[1] (Hammond, Prahalad 2004) represents a large and so far mostly untapped market that increasingly attracts firms all over the world (Prahalad 2012). However, serving the BoP with compatible products, services and business models requires a fundamentally different set of capabilities, resources and approaches than operating in established Western markets (Prahalad, Hart 2002, 1999). The new product development for the BoP calls for different, BoP specific innovation focus, sources and processes (Viswanathan, Sridharan 2012; Prahalad 2012; Nakata, Weidner 2012). So far research provides only very limited knowledge and practical guidance on how to innovate for the BoP (Nakata 2012). Although literature stresses the importance of user orientation, involvement und co-creation as key success factors of innovation for the BoP (London, Hart 2004; Viswanathan, Sridharan 2012), even less is known with regard to indigenous or user innovation at the BoP (Nakata 2012). Enhancing the current discussion of BoP people as consumers (Prahalad 2010) and as producers (Karnani, Aneel 2009; London et al. 2010; Hahn 2009), this paper contributes to the relatively new perception of BoP people as source of innovations (Gupta 2006) and entrepreneurs (Christensen et al. 2010) analyzed from a User Innovation perspective.

The paper starts with laying foundations in the fields of BoP and User Innovation and then presents the research context and methodology of the study. We will present first our descriptive and comparative analysis of a large Indian BoP consumer innovation sample. We will then closer analyze the effects of knowledge, context and demographic factors on

[1] Aggregated annual income of the 18 biggest emerging economies' population with per capita income under $1 per day

innovation value and ultimately market recognition. Finally the paper concludes with first managerial implications and suggestions for further research.

2. Background and literature review

Base of the Pyramid

The so-called "Base of the Pyramid" or "Bottom of the Pyramid" (BoP) describes a cross-national population group living at the lowest level of the economic or income pyramid. More than a billion people or one fifth of the world population lives from less than 1 USD per day (Prahalad, Hart 2002). The BoP business concept predominantly popularized by C. K. Prahalad (Prahalad 2010) emphasizes an economic point of view on the BoP as a large and so far mainly untapped market with consumers and production resources opposed to the idea of passive development aid recipients. The involvement of the private sector with its resources, know-how and skills allows to increase the quality of life through affordable products and services and to create entrepreneurial opportunities for the poor to lift themselves out of poverty (Prahalad, Hart 2002; Hammond, Prahalad 2004). Furthermore, the BoP is a huge market with a combined Purchasing Power of more than a billion USD[2] (Hammond, Prahalad 2004) and high projected growth rates. Therefore more and more companies seeking for new growth opportunities recognize the BoP as an attractive new market that has so far been ignored (London et al. 2010; Acosta et al. 2011).

However, companies need to overcome various challenges and offer specific BoP compatible business models and product portfolios compatible in order to be successful at the BoP (The Economist 2010; Prahalad, Hart 2000). For example products and services obviously need to be affordable and offered at a very low price ideally in combination with alternative payment and revenue models (Anderson, Markides 2007). Needs, tastes and preferences of the BoP do not only differ significantly from the developed world but also within the BoP market itself,

[2] Aggregated annual income of the 18 biggest emerging economies' population with per capita income under $1 per day

caused through the various e.g. geographic, cultural, and religious zones covered by the BoP (Hammond, Prahalad 2004; Banerjee, Duflo 2007). A large share of the population lives in remote rural areas or urban slums without any existing distribution or communication networks that could be used for product delivery, information and advertisement (Prahalad, Hart 2000, 1999). In addition, companies may face religious, racial and political conflicts and at same time have to cope with corruption, pirating and inefficient governmental enforcements (Anderson, Billou 2007; Hammond, Prahalad 2004). For many products so far unorganized or even nonexistent markets have to be created, e.g. the consumer has to informed and educated with regard to a specific need and corresponding products (Anderson, Markides 2007). In order to overcome these challenges and develop appropriate new products, innovation is required in all areas ranging from market creation and entire business models to product design (Prahalad, Hart 2002; Prahalad, Mashelkar 2010).

Innovation, however, requires detailed and in-depth information on the BoP needs and solution spaces that is difficult to access and highly sticky (information stickiness is defined as "… the incremental expenditure required to transfer that unit of information to a specified location…" von Hippel 2010) (Prahalad, Hart 2002). Literature emphasizes the importance of user involvement and co-creation as a key success factor to access detailed information on need and solution spaces and to develop successful products (London 2007; London, Hart 2004; Viswanathan, Sridharan 2012; Weidner et al. 2010). In addition to a general call for research and guidelines on innovation for the BoP, a specific need for research on the BoP users' role as source and co-creator of innovations has been expressed (Nakata, Weidner 2012; Nakata 2012; Viswanathan, Rosa 2010).

User Innovation

Empirical research proves that users of product and services often play an essential role for the development of new products and can be an important source of innovation (von Hippel 1995). In fact many of the most important and industry shaping product innovations that we can now buy from producers were originally initiated, invented and developed by users (de Jong, von Hippel 2009). Shah (Shah 2000) even shows that 100% of all first type innovations and 58% of all major improvements relating to three different outdoor-sports activities originate from innovating users who experienced so far unmet needs. Furthermore user innovation can be classified as a quite common phenomenon: e.g. Herstatt and von Hippel (Herstatt, von Hippel 1992) find that 36% of industrial pipe hanger hardware users innovate and Lüthje (Lüthje 2000) identifies a share of 37% of all consumer users of outdoor-sports equipment who develop ideas for new or improved products. In the context of user innovation we define users as "… firms or individual consumers that expect to benefit from *using* a product or a service. In contrast, manufacturers expect to benefit from *selling* a product or a service" (von Hippel 2010). Thus, according to this definition the term *user* embraces end consumer users as well as intermediate users who employ a producer's products and components to the creation process of another product or service (Bogers et al. 2010) such as surgeons (Lettl et al. 2006), librarians (Morrison et al. 2000) or firms applying industrial instruments (von Hippel 1976). Several studies have explored and confirmed the relevance of user innovation for the production of industrial goods (Urban, von Hippel 1988; Franke, Hippel 2003) and explored value and techniques of co-creation and integration of innovating users to producers (Lilien et al. 2002; Thomke, von Hippel 2002). Subsequently, research has been extended to innovating end consumers highlighting the importance of user innovation as source of innovation (Lüthje 2000; Shah 2000; Raasch et al. 2008). User innovation research so far focuses on a relatively narrow niche of leisure and sports related consumer goods generated within a community environment (von Hippel et al. 2010). Only two very recently

single broad and comprehensive studies in the UK (von Hippel et al. 2010), the US and Japan (Ogawa, Pongtanalert 2011; Hippel et al. 2011) examined the phenomenon across an entire consumer population and consequently opened up a new research area labeled consumer innovation (von Hippel et al. 2011), a term that we will adopt for this paper as well. Von Hippel et al. (von Hippel et al. 2010) found user innovation to be a phenomenon of considerable size and scope with a share of 6,1% of innovating consumers in the UK. In order to investigate generalizability there is a clearly stated need to conduct further broad consumer innovation studies in other countries (von Hippel et al. 2010) and moreover no comprehensive study on consumer innovation in developing countries and under different, resource-constraint living conditions has so far been conducted.

An unmet need is typically the trigger for a user innovation. The user expects to benefit from his solution via the use, sale or enjoyment of the development process (Bogers et al. 2010). In comparison to producer innovation user innovation is more likely to occur if need information is sticky and therefore costly to transfer (von Hippel 1994). During the creation process a user applies his locally available solution knowledge to the development of the innovation (Lüthje et al. 2005). While addressing how producers can identify and take advantage of innovating users, literature explores which users are most likely to create commercially attractive innovations (cf. Morrison et al. 2000; Franke, Shah 2003; Lüthje 2004; Hippel et al. 2011; Franke et al. 2006). Very limited research, however, has so far investigated the antecedents of this likelihood to create commercially attractive innovations namely demographic, contextual, knowledge-related and motivational factors (cf. Schreier, Prügl 2008). This holds especially true regarding their influence on the quality or value of the resulting innovation.

3. Hypothesis development

Evidence from the developed world shows that producers can profit considerably through integration of innovating users into their new product development work (cf. Herstatt, von

Hippel 1992; Lilien et al. 2002). The highly accentuated need for customer co-creation at the BoP (Viswanathan, Sridharan 2012) also suggests a high if not even higher relevance for BoP innovations. But at least to our knowledge this has not been analyzed yet. We therefore focus here on consumer innovation at the BoP to generate insights on differences as well as communalities to user innovation in the developed world. We will characterize innovating users, and look closer at behavioral patterns and results of their work. In order to pursue this we analyze the antecedents of user innovation in this study. Lüthje et al. (Lüthje et al. 2005) and Franke et al. (Franke et al. 2006) suggest that users apply locally available information and resources to detecting needs and the development of appropriate solutions. Given the resource constraint living conditions at the BoP in combination with limited access to information sharing and providing infrastructure such as the internet, libraries and community memberships, a less diluted effect of knowledge, context and demographic factors on the innovativeness of BoP users can be investigated. In accordance with previous creativity and user innovation research (Magnusson 2009; Im, Workman Jr 2004; Piller, Walcher 2006; Amabile 1982) our dependent variables *creativity* and *technical elaboration* measure the value or quality of an innovation. Furthermore innovation success and market response to an innovation is measured via the third dependent variable *market recognition*.

First we assess the effect consumer knowledge factors on the innovation quality that is creativity and technical elaboration followed by an effect analysis of innovation quality and contextual factors on market recognition.

Knowledge related hypothesis

Possession of knowledge does not only determine a consumer's propensity to innovate but also the quality of the developed idea (von Hippel 1994; von Hippel 2010). Successful innovations require relevant technical knowledge in order to detect technical opportunities and limitations of product ideas and subsequently to implement ideas into reality (Lüthje 2004; von Hippel 1994; Magnusson 2009). Therefore, we hypothesize:

H1a: Consumer's technical experience with the underlying technology is positively related to their ability to generate creative innovations

H1b: Consumer's technical experience with the underlying technology is positively related to their ability to generate technically elaborated innovations

Consumers who innovate frequently gain innovation experience and draw every time on the personal knowledge pool at their disposition. Innovative creativity, however, is driven through the new combination of existing knowledge elements. If a consumer innovates on a regular basis and has already combined parts of his knowledge into an innovation, another creative and new combination of his personal knowledge pool becomes less likely (Kalogerakis et al. 2010) Baldwin et al. (Baldwin et al. 2006) observe this phenomenon regarding design spaces, which include all possible combinations of a single class of objects such as rodeo kayaks. The more designs of a given design space are explored the more the design space gets exhausted. Conversely, a consumer's innovation experience increases his technical knowledge and experience that he employs analog to hypothesis 1b to generate his innovation. Thus, we hypothesize:

H2a: Consumer's innovation experience is negatively related to their ability to generate creative innovations

H2b: Consumer's innovation experience with is positively related to their ability to generate technically elaborated innovations

Evidence from studies conducted by Wuchty et al. (Wuchty et al. 2007) and Schettino et al. (Schettino et al. 2008) suggests that innovation quality of inventions generated by at least 2 innovators is higher than inventions developed by a single innovator. Cooperation does not only increase the overall technical knowledge and idea pool available to the innovation process but allows a more critical evaluation and selection of individual contributions by the innovator team. Therefore, we hypothesize:

H3a: Cooperation with others during the innovation creation process increases a consumer's ability to generate creative innovations

H3b: Cooperation with others during the innovation creation process increases a consumer's ability to generate technically elaborated innovations

The knowledge a consumer gains through his use experience of similar products and generally within the application area of the innovation, helps him to detect unfulfilled needs and requirements (Lüthje 2004; Magnusson 2009). It enables an innovator to know the performance attributes of an innovation, to generate suitable solutions and puts him into the distinctive position to evaluate whether a solution matches the requirements or not (Lüthje 2004; Schreier, Prügl 2008). While a user can exploit his use information to develop useful and novel ideas on performance attributes, more specifically creative ideas, we assume that a consumer's existing use experience does not influence the elaboration of its technical realization (Magnusson 2009). We can therefore hypothesize:

H4: Consumer's use experience increases the ability to generate creative innovations

Evidence suggests education is an essential ingredient for creative performance (Amabile 1983). A higher education increases one's general information stock and abilities required to understand and structure problems as well as subsequently to recognize opportunities and to generate adequate solutions (Shane 2000). On the other hand, technical elaboration is expected to be positively associated with education analog to hypothesis 1b as it increases a consumer's stock of basic technical knowledge he can draw on. Hippel et al. (von Hippel et

al. 2010) emphasize the importance of education by finding that consumers with a university degree are more likely to innovate than consumers with lower education levels. Thus, we hypothesize:

H5a: Consumer's level of education relates positively to the ability to generate creative innovations

H5b: Consumer's level of education relates positively to the ability to generate technically elaborated innovations

Context related hypothesis

The innovation context describes the circumstances and conditions under which a consumer produces his innovation. Of course the BoP is special and differs dramatically from the conditions in the developed world. In our study we investigate the effect of a BoP consumer's initial motivation and impulse to innovate as well as the innovation type on the BoP market recognition. Nakata and Weidner (Nakata, Weidner 2012) propose that the social context plays an important role for the new product adoption, thus market recognition at the BoP. Innovations are therefore assumed to be more successful if oriented toward and inspired by greater social needs "…because of the group emphasis [the BoP's group-oriented social milieu], new product adoption is not motivated principally or exclusively by personal needs but rather by the welfare and preferences of the collective" (Nakata, Weidner 2012). Furthermore successful products for the BoP have to differ significantly from solutions for the developed world and maximize functionality and compatibility (London, Hart 2004; Prahalad, Hart 2000). Given that most existing products in circulation are based on developed world solutions and that the integration of many new functionalities, it requires more than just incremental changes to innovate successfully for the BoP. Therefore we expect radically new created products to be more successful at the BoP than modified products. This leads us to hypothesize:

H6: Innovator's prosocial motivation increases the innovation's degree of market recognition

H7: New products created from scratch attain a higher degree of market recognition than product modifications

Innovation quality related hypothesis

New products that embrace novel and relevant ideas as well as their high quality implementation into reality (Mahr, Lievens 2011; Amabile 1983) are most likely to yield market success especially at the BoP (Prahalad 2012). Creative solutions offer significant value to customers through meaningful product differentiation and competitive advantages, which translates into new product success (Im, Workman Jr 2004). Extreme requirements for products at the BoP with regard to e.g. adaptability, robustness, compatibility and at the same time affordability calls for technically elaborated innovation (Nakata, Weidner 2012; Prahalad, Hart 2002; Prahalad 2012). Therefore, we hypothesize:

H8: Innovation creativity relates positively to the innovation's degree of market recognition

H9 Innovation technical elaboration relates positively to the innovation's degree of market recognition

4. Methodology

For our analysis of consumer innovation at the BoP we adopt a hybrid approach (Edmondson, Mcmanus 2007). The approach of this paper at the intersection of a relatively well analyzed research field (user innovation) and relatively new and unexplored research areas BoP and BoP innovation includes descriptive as well as cause-and-effect analysis including hypothesis testing (Edmondson, Mcmanus 2007; Sekaran, Bougie 2010). Additionally, consumer innovation studies across large population samples are still rare and the call for further large population studies including cross-validation of existing findings in another reality

(Edmondson, Mcmanus 2007), more specifically poor and developing population groups, will be answered (von Hippel et al. 2010; Hippel et al. 2011).

The sample

We base our analysis on secondary data provided by the National Innovation Foundation (NIF) in India. The NIF in collaboration with the Honey Bee Network has scouted and documented more than 100,000 innovations and traditional knowledge coming from the BoP in India. An expert jury selects and awards BoP contributors on a regular basis, which are featured on the NIF website together with a detailed description of innovator and his innovations (Bhaduri, Kumar 2011; Utz, Dahlman 2007; Gupta 2006; Klaus Sieg 2011). Two examples of awarded innovations are:

- A device developed by C. Mallesham to mechanize the process of hand winding of yarn for the traditional silk sari production relieving women from the drudgery of manual work and reducing time from 4 hours to 1,5 hour for one sari (National Innovation Foundation)

- A small refrigerator created by M. Prajapati out of clay that keeps vegetables, fruits, milk and water cool without any external source of energy through a natural cooling process (National Innovation Foundation)

Our full sample comprises 425 innovations from 5 award functions[3] and embraces innovators from 22 Indian states. In order to retrieve information on innovator and innovation, which is only available in form of running text, we operationalized all relevant information via coding procedures into variables. Given the different degrees of descriptive detail, a reduced sample of 267 ideas is complete with regard to the set of retrieved variables and therefore, sample size by analysis depends on the variables under investigation.

[3] The award functions took place in 2001, 2002, 2005, 2007, 2009; a total of 74 ideas were excluded after a careful screening process because they were either traditional or community knowledge, pure abstract ideas or simply lifetime achievement awards without direct reference to any innovation

Measures and methods

Data from the website is quantified through codification (Strauss, Corbin 1991). Following a similar procedure as Hippel et al. (von Hippel et al. 2010) with their broad consumer study in the UK, we focused hereby on demographic, knowledge and context variables. With regard to the demographic variables we collect information on the innovator's *gender* (male/female), his place of *residence* (Indian state), his *age* classified into the respective age groups (10-17, 18-24, 25-23, 35-44, 45-54, 55-64, 65+) and his *profession* category (farmer, craftsman, education & health, administration, students, simple workers & unemployed)[4]. Knowledge and resources available to the innovator were assessed via his highest completed *education* level (illiterate, primary (level 1-5), middle (level 6-8), secondary (level 9-10), higher secondary (level 10-12), graduated, higher studies), if he possesses *technical experience* in the innovation field via his profession (Yes/No), if he is a *user* of the innovation, thus has use information (Yes/No), if he is a *serial innovator* disposing of innovation experience through more than a single innovation (Yes/No), and finally if he assesses additional knowledge through *cooperation* during the innovation process (Yes/No). Contextual factors include the creation *industry* of the innovation (agriculture, manufacturing, water & sewerage, construction, information, arts)[5], the addressed *need* (food production, food preparation, water supply, clothing, hygiene & health, energy, transportation, household, tools & crafting, hobby & sports, other), if *prosocial motivation* was at the origin of the innovation effort (Yes/No) and lastly the *innovation type* (creation/modification). Finally the innovative outcome is measured though the first order construct *market recognition* where an innovation gets a point for each of the fulfilled underlying drivers with possible scores from 0 to 4 (awarded (Yes/No), diffused (Yes/No), adopted (Yes/No), commercialized (Yes/No)). Furthermore

[4] Classification in accordance with Bundesagentur für Arbeit (Bundesagentur für Arbeit) and International Labour Organization (International Labour Organization)

[5] Classification in accordance with United Nations (United Nations Statistics Division 2012)

Creativity and *technical elaboration* are not directly deducted from the NIF website but assessed via the Consensual Assessment Technique (Amabile 1982).

Due to the lack of functional measures for innovative outcome, we applied the Consensual Assessment Technique (CAT) developed by Amabile (Amabile 1982). CAT was originally designed to assess creativity but beyond that, it has already been successfully used to determine product innovativeness and innovativeness of user ideas or user contributions (Piller, Walcher 2006; Mahr, Lievens 2011; Magnusson 2009). Amabile found that no consistent and objective definition of creativity can be formulated but that independent judges typically recognize creativity and agree if something is creative. Therefore, we asked expert judges to apply their own, subjective definition of creativity and technical elaboration to the assessment and to evaluate every idea relative to the entire sample. The jury individually rated every innovation from 1 to 4 (scale corresponding from 'very low' to 'very high') on the dimensions *creativity* (composed of the notions of novelty and relevance) and *technical elaboration* as recommended by Amabile (cf. Amabile 1982; Amabile 1996). In order to generate a relative assessment of idea quality, we select a reasonably homogenous set of ideas from the entire database. A total of 195 complete manufacturing and construction ideas are forming a comparative sample of engineering related innovations. The jury consisted in 11 higher master students with know-how and experience in engineering and product design. Analysis of inter-judge reliability via Cronbach's Alpha shows sound reliability levels for creativity (0,80) as well as technical elaboration (0,83) (Osborne 2008). Given these reliable results we averaged individual evaluations into single scores for creativity and elaboration (cf. Magnusson 2009). Kolmogorov-Smirnov tests (Osborne 2008) confirm normal distribution of the two variables.

5. Findings

Descriptive analysis and comparison

Our descriptive analysis (table 1) shows that out sample consists in innovations from various states across India (a total of 22 different Indian states).

Variable	Values and percentages	Innovation by Indian state
Industry N=425	Manufacturing (79%), agriculture (18%), construction (1%), water & sewerage (1%), other (<1%)	
Profession[1] N=399	Farmers (40%), craftsmen (34%), education & health (13%), students (10%), simple workers & unemployed (5%), administration (4%)	
Technical experience N=394	Work experience in industry (56%), no work experience in industry (44%)	
Serial innovator N=437	Serial innovator (53%), one-time innovator (47%)	
User status N=439	User (85%), no user (15%)	

1 Thereof 19 double entries

Table 1: Distribution of descriptive information on BoP innovators and innovations

The majority of innovations fall into the manufacturing (79%) and agricultural industry (18%). Hence, most consumers manufacture products such as machinery and tools, electrical, electronic or transportation related products, chemicals as well as pharmaceuticals or create crop and animal production related innovations. The average consumer innovator works as farmer (40%) or craftsmen (34%). Slightly more than half of the innovators have already innovated more than once (53%) and possess relevant technical experience in the creation industry of the innovation (56%). The vast majority of them with 85%, however, is also a user of their innovation and therefore disposes of related use information.

Variable		BoP	UK
Innovation type	Creation (vs. modification)	65%	33%
Cooperation	Vs. development in isolation	11%	10%
Prosocial motivation	Vs. egoistic motives as initial motivation to innovate	24%	15%
Gender	Male (vs. female)	95%	87%
Needs	Craft & shop tools	7%	23%
	Sports & hobby	2%	20%
	Household/dwelling	5%	16%
	Transportation/vehicle	10%	8%
	Hygiene, health, medical	5%	2%
	Other[1,2]	71%	31%

1 BoP non-comparable needs: Food production (41%), food preparation (11%), water supply (10%), energy (4%), clothing (2%), other (2%)

2 UK non-comparable needs: Gardening (11%), child-related (10%), pet-related (3%), other (7%)

Innovation sharing (in percent) BoP UK

Diffused

Adopted

Commercialized

Innovator's education level (in percent)

No education

Less educated

High school/secondary

Further qualification

Higher studies

Innovator's age (in percent)

10-17 18-24 25-34 35-44 45-54 55-64 65+

N by variable varies between 74 and 104 for UK and 330 and 439 for BoP

Table 2: Comparison of BoP consumer innovators and innovations with the UK (von Hippel et al. 2010)

Comparing our BoP consumer innovation data with the outcome of the UK study (von Hippel et al. 2010), we recognize similar patterns as well as differences. Almost two third (65%) of the BoP consumer innovation consists in creating new products from scratch whereas UK consumers focus on incremental improvements of existing products (67%). Both consumer groups very rarely produce their innovation in cooperation with others (BoP: 11%, UK 10%), are less prosocially motivated but motivated by their own needs (BoP: 24%, UK: 15%), although BoP innovators are more prosocially motivated compared with UK consumers. The typical innovator is male in both cases, the UK (87%) as well as the Indian BoP (95%). Similar need categories inspire consumers to innovate: craft & shop tools, sports & hobby, household, transportation and health related needs while except for transportation (10% of all innovations) all other categories play a minor role (19% in total) at the BoP with significantly less importance than in the UK (69% in total). BoP consumers primarily fulfill needs with regard to food production (42%), food preparation (11%) and water supply (10%). Other important categories in the UK refer to gardening (11%) and child related (10%) needs. At the BoP the share of innovations diffusion (47% vs. 33%), adoption (32% vs. 17%) and

commercialization (20% vs. 4%) is higher than in the UK. Expectedly, BoP consumer innovators are less well educated then their counterparts in the UK but surprisingly both consumer groups have comparable average ages (UK: 50 years, BoP: 47 years)[6].

Hypothesis testing

We conducted two multiple linear regressions to test our earlier formulated hypothesis with regard to the knowledge effects on creativity and technical elaboration respectively and additionally an ordinal logistical regression to test hypothesis with regard to the effects on market recognition. Two control variables, gender and age, were included in all three models. We will discuss findings in the following discussion section.

The overall multiple linear regression model for creativity proves to be valid predicting a statistically significant share of the dependent variable's variance with $p<0,01$. Hence, the multiple linear regression model explains 7% of the variance of creativity ($R^2=0,113$; adjusted $R^2= 0,071$; $F_{(9;190)}=2,702$; $p=0,006$)[7]. Investigation of the individual regression coefficients by independent variable in Table 3 provides insights with regard to magnitude and direction of their relationships with creativity. Keeping all other independent variables controlled, 3 independent variables show significant associations with creativity. In line with ***hypothesis 2a***, a serial innovator reaches lower creativity scores than a one-time innovator (B=-0,0211; p= 0,002). Furthermore, ***hypothesis 3a*** is supported as an innovation developed via a process including cooperation activities achieves higher creativity results (β=0,232; p=0,019) than an innovation by a single innovator. Finally disposing of innovation related technical experience results in higher creativity scores (B=0,142; p= 0,032), which leads as to affirm ***hypothesis 1a***. Serial innovator (B=-0,230) is identified as the variable with the highest predictive power

[6] Excluding all BoP innovators under 18 because consumers needed to be at least 18 to participate in the UK study

[7] Statistical assumptions of linearity, homoscedasticity, normality and independence of error terms, absence of multicollinearity and influential outliers were verified, no violation of assumptions validated the regression results (Hair et al. 2010)

followed by cooperation (β=-0,175) and finally by technical experience (β=-0,162) (cf. Backhaus 2008). No evidence can be found to support ***hypothesis 4*** and ***hypothesis 5a***.

		B	SE	β	t	p value
Intercept		2,684	,166		16,127	,000
Age		,017	,021	,064	,801	,424
Education		-,001	,023	-,004	-,053	,957
Cooperation	Cooperation (vs. solitary effort)	**,232**	**,098**	**,175**	**2,361**	**,019 ***
Prosocial	Prosocial motivation (vs. egoistic motives)	,067	,078	,071	,854	,394
Serial	Serial innovator (vs. one-time effort)	**-,211**	**,066**	**-,230**	**-3,207**	**,002 ****
Techn. exp.	Technical experience (vs. none)	**,143**	**,067**	**,162**	**2,156**	**,032 ***
Type	Creation (vs. modification)	-,040	,071	-,040	-,569	,570
User	User (vs. no user)	,009	,087	,009	,103	,918
Gender	Female (vs. male)	-,165	,185	-,064	-,889	,375

N= 200; R^2= 11,3%; Adjusted R^2= 7,1%; * = p < 0,05 ** = p < 0,01

Table 3: Coefficients of multiple linear regression model for creativity

The overall model for technical elaboration proves to be valid predicting a statistically significant share of the dependent variable's variance with p<0,01. Hence, the multiple linear regression model explains 7% of the variance of technical elaboration (R^2=0,109; adjusted R2= 0,066; $F_{(9;190)}$=2,572; p=0,008)[8].

		B	SE	β	t	p value
Intercept		2,385	,181		13,205	,000
Age		,010	,023	,033	,417	,677
Education		**,043**	**,025**	**,127**	**1,762**	**,080 †**
Cooperation	Cooperation (vs. solitary effort)	,073	,107	,051	,683	,496
Prosocial	Prosocial motivation (vs. egoistic motives)	,076	,085	,075	,895	,372
Serial	Serial innovator (vs. one-time effort)	-,071	,072	-,071	-,989	,324
Techn. exp.	Technical experience (vs. none)	**,261**	**,072**	**,273**	**3,611**	**,000 ****
Type	Creation (vs. modification)	-,078	,077	-,071	-1,017	,310
User	User (vs. no user)	-,038	,094	-,033	-,400	,689
Gender	Female (vs. male)	-,210	,201	-,076	-1,045	,297

N= 200; R^2= 10,9%; Adjusted R^2= 6,6%; † = p < 0,10 ** = p < 0,01

Table 4: Coefficients of multiple linear regression model for technical elaboration

[8] Statistical assumptions of linearity, homoscedasticity, normality and independence of error terms, absence of multicollinearity and influential outliers were verified, no violation of assumptions validated the regression results (Hair et al. 2010)

Table 4 gives on overview on the regression coefficients by independent variable. Controlling for the effects of all other independent variables, 2 variables show significant associations with technical elaboration. An innovator who possesses technical experience concerning the corresponding innovation will on average achieve higher technical elaboration scores than innovators who do not (B=0,261; p=0,000). Thus, findings support ***hypothesis 1b***. Raising the significance threshold to a significance level of p<0,10, education also shows a positive association with technical elaboration in line with ***hypothesis 5b***. Thus, an increase in the innovator's highest completed education level raises the innovation's technical elaboration results (B=0,043; p=0,080). Standardized beta weights highlight the importance of technical experience (β= 0,273) in contrast to education (β= 0,127) (cf. Backhaus 2008). No evidence can be found to support ***hypothesis 2b*** and ***hypothesis 3b***.

Market recognition is measured on an ordinal scale ranging from 0 as lowest to 4 as highest value and doesn't follow a normal distribution. Given these limitations of this single dependent variable, we conducted an ordinal logistical regression (Gerpott, Mahmudova 2006) to measure the impact of innovation quality, namely creativity and technical elaboration, as well as the context, specifically prosocial motivation and innovation type, on market recognition. User status was the only knowledge variable without any evidence for significant influence on creativity and technical elaboration. We therefore added user status as independent variable to the ordinal logistical regression model. The quality of the overall model and its goodness-of-fit with the data is appraised twofold. The likelihood method rejects on a significance level of p<0,001 the null hypothesis that a baseline model and our model predict equally well market recognition (Norušis 2012; Backhaus 2008). Furthermore the Pearson and deviance statistics do not reject the null hypothesis that the model fit is good (p>0,01), thus are supporting model validity and quality (cf. Norušis 2012). The Nagelkerke

coefficient of determination indicates a variance explanation of approximately 19 percent (cf. Gerpott, Mahmudova 2006)[9].

		B	SE	OR	Wald	p value
Threshold	Success = 0	-1,79	,82	-	-	-
	Success = 1	,51	,81	-	-	-
	Success = 2	1,45	,81	-	-	-
	Success = 3	2,03	,82	-	-	-
Creativity	Creativity score (standardized)	**,37**	**,17**	**1,44**	**4,64**	**,03 ***
Technical	Technical elaboration score (standardized)	,11	,17	1,11	,40	,53
Age	Age (standardized)	,00	,14	1,00	,00	1,00
Prosocial motivation	Prosocial motivation (vs. egoistic motives)	**,76**	**,34**	**2,14**	**5,12**	**,02 ***
User status	No user (vs. user)	**1,11**	**,38**	**3,03**	**8,71**	**,00 ****
Type	Modification (vs. creation)	,20	,31	1,22	,43	,51
Gender	Male (vs. female)	-,02	,81	0,98	,00	,98

N= 200; Nagelkerke pseudo R^2 = 18,7%; * = p < 0,05 ** = p < 0,01

Table 5: Coefficients of ordinal logistical regression model for market recognition

The model overview in table 5 shows parameter estimates for thresholds and factors of the ordinal logistical regression. Beta coefficients and their transformation into odds ratios for independent variables are the relevant measures to interpret the effect on the dependent variable. A positive Beta coefficient is hereby associated with an effect towards a higher category of the dependent variable whereas a negative coefficient is associated with an effect towards a lower category. Effect size in terms of direction and strength is interpreted through the odds ratio. Creativity (B= 0,37; odds ratio= 1,44), prosocial motivation (B= 0,76; odds ratio= 2,14) and user status (B= 1,11; odds ratio= 3,03) all show a positive and significant association with market recognition and thereby support ***hypothesis 7*** and ***hypothesis 6***. A unit increase of creativity raises the odds to achieve a higher category of market recognition by approximately 1,5. Odds ratios for dichotomous variables are interpreted against their base category. Therefore the odds for a prosocially motivated innovation to achieve a higher

[9] No violations of statistical assumptions of linearity of logits, absence of multicollinearity and proportionality of odds were detected; proportionality of odds is confirmed through separate tests of parallel lines by independent variable and binary logistical regression models for each threshold

market recognition level are more than twice the odds for an egoistically motivated innovation. Conversely the odds to attain a higher market recognition category for an egoistically motivated innovation are approximately half (odds ratio= 0,47) the odds for a prosocially motivated innovation. Furthermore, the odds to achieve a higher market recognition level for innovations by non-users are more than thrice the odds of an innovation produced by a user. Conversely the odds to attain a higher market recognition category for an innovation by a user are one third (odds ratio= 0,33) the odds of an innovation produced by a non-user. Technical elaboration and innovation type as well as the control variables gender and age are not associated with market recognition and their odds ratios are close to 1 (cf. O'Connell 2006; Gerpott, Mahmudova 2006). Therefore we find no evidence to support ***hypothesis 7*** and ***hypothesis 9***.

6. Discussion and conclusion

Discussion

In this paper we looked closer at the phenomenon of consumer innovation at the BoP in India. Based on data of the NIF we found that most of this innovation falls into two industry fields, manufacturing and agriculture, and is conducted by male farmers and craftsmen. In comparison to consumer innovation in the developed world represented by the UK sample, it becomes obvious that consumer innovation in both population groups follows similar patterns but also shows differences. These can be largely explained by differences of needs as well as major differences in living standards. Understandably consumers at the BoP are more concerned with basic needs and elementary products such as food, production and preparation as well as water and energy supply whereas UK consumers mostly innovate in improving existing products, for example in combination with leisure activities (von Hippel et al. 2010). Both innovator groups innovate in isolation and are predominantly motivated by their own, personal needs. While UK consumers focus on incremental innovation by modifying products, BoP consumers create new solutions. This can be explained by the resource-constraint living conditions at the BoP with a small amount of existing products affordable and available to the innovator (Viswanathan, Sridharan 2012) as well as the need for distinct functionality (Prahalad, Hart 2000). Consumer innovations by BoP innovators are shared more widely than in the UK. Imperfect market conditions and people's need in particular for products improving their living conditions (Nakata, Weidner 2012; Viswanathan, Sridharan 2012), possibly create a more welcoming environment for consumer innovation. In opposition to the UK, a higher education level does not seem to translate into a higher likelihood to innovate for the on average less educated BoP consumers.

We find that BoP innovators apply their knowledge derived from technical experience, and cooperation resources to the innovation and thereby increase the degree of creativity.

Furthermore we can confirm our assumption that repeated innovation activity decreases the level of creativity. However, we find no evidence that being a user of the innovation and therefore possessing direct use information related positively to the degree of creativity. A plausible rationale could be that people at the BoP are embedded in strong social networks (Nakata, Weidner 2012; Viswanathan et al. 2010) allowing them to derive very detailed and in-depth information on needs and use situations substituting the advantage of direct and own information. Furthermore, basic needs satisfied through BoP consumer innovations may involve more intuitive and generic use information opposed to idiosyncratic needs from e.g. kite surfing, canyoning or sailplaning (Franke, Shah 2003; Lüthje 2004). Also, education does not seem to influence the level of creativity. Other drivers such as innate abilities and training (Amabile 1983) could possibly be more important drivers for the cognitive skills required to structure and solve problems at the BoP. We find that technical experience does not only increase creativity but technical elaboration of the innovation as well. Furthermore, education is a driver for the level of technical elaboration. Conversely, innovation experience and cooperation do not seem to increase the pool of technical knowledge applied to the production of more technically elaborated innovation. The recognition of these BoP consumer innovations seems not to depend on whether it is newly created or modified product or how well the idea is technically realized but on the creativity of the innovation. Novelty and relevance of the product, in other words the possibility to satisfy important and so far unmet needs, are in the focus even if the product is technically not perfect. Contrary to studies from user innovation in the developed world finding that being a user relates positively to the attractiveness of an innovation (Schreier, Prügl 2008; Franke et al. 2006), not being a user and being prosocially motivated increases the innovation's degree of market recognition at the BoP. The underlying inspiration to serve "… the welfare and preferences of the collective" (Nakata, Weidner 2012) obviously play a very important role at the BoP.

Conclusion

This paper contributes to the relatively new research field into user innovation patterns across a large consumer population. We analyzed the phenomenon in a new setting, more precisely in a developing country among a very poor population group. We find that consumer innovation does not only exist in developed countries but with adaptation also under poor and resource-constraint living conditions. We further contribute to research on the effect of local knowledge resources on innovation quality and factors explaining the degree of BoP market recognition of consumer innovations. Limitations of our study consist in our sample based on indirect data, which is biased through the NIF collection and selection process. Furthermore, our sample concentrates on the BoP in India only. Looking forward, further research has to be conducted at the BoP in other countries to further generalize findings. Other interesting questions for ongoing research could be on how to integrate BoP consumers into the innovation process of companies, for example how can a highly-educated and internationally experienced engineer and someone from the BoP effectively and trustfully collaborate with each other and how does this joint innovation effort ultimately benefit the BoP.

Our findings hold implications for innovating firms as well. We can conclude that in order to be successful at the BoP, companies need to look for opportunities to co-create with people from the BoP. Demand for new products at the BoP is highlighted by the high degree of market recognition of innovations developed by BoP consumers themselves with an adoption rate of almost one third. Our results suggest companies should focus on useful products rather than technical breakthroughs relating to basic needs and collective welfare. Consumer innovation exists at the BoP and can be a potentially very valuable source of product innovation. Managers should therefore try to integrate innovative BoP consumers into their innovation work and to carefully explore their needs as well as concepts, prototypes or products, developed by them. These *solution spaces* can then be explored as a starting point to co-create products with BoP consumers and to test and evaluate such solutions concerning their potential to attract other BoP consumers. Low education levels should not be seen as a

hurdle here, but according to our research a (minimum) level of technical capability is a useful indicator to identify promising BoP consumers who innovate.

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