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Reversing the Flow of Ideas? Frugal Innovation for India and the World beyond

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February – March 2013

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Introduction

This essay will examine the historical significance of frugal innovation and reverse innovation, terms which have attracted much scholarly and policy attention. To Tiwari and Herstatt (2012:4), frugal innovation generates "new or significantly improved products (both goods and services), processes, or marketing or organisational methods that seek to minimise the use of material and financial resources in the complete value chain (development, manufacturing, distribution, consumption, and disposal) with the objective of reducing the cost of ownership while fulfilling or even exceeding certain pre-defined criteria of acceptable quality standards." As *The Economist* (2010) points out, frugal innovation is not merely about cutting costs; frugal products must also be robust and easy to use, they must use raw materials sparingly and in ways which minimise their effect on the environment.

Frugal innovation draws inspiration from the term frugal engineering which was first used in 2006 by Carlos Ghosn, the head of the alliance between the automobile firms Nissan and Renault, to describe the challenge of designing in resource-constrained environments. [1] Since then, frugal innovation has attracted much attention for at least two reasons. First, it provides a means of conceiving products and services for emerging markets in a manner that goes beyond merely providing stripped-down versions of existing offerings designed for more

affluent markets and customers. In other words, frugal innovation opens potentially vast new markets, particularly at the bottom of the pyramid (BoP) – which refers to an estimated four billion people living on less than US$2 a day, mostly in Africa, Asia and Latin America (Prahalad, 2009). The quest for such new markets has become more intense as the population of the affluent world – Europe, Japan and North America – either stagnates or declines.

Second, Govindarjan and Trimble (2012) argue that, for multinational enterprises (MNEs), especially those from affluent countries, frugal innovation offers the opportunity to draw on a range of ideas. The rationale is that if products and services can be designed for demanding conditions, it should also provide a basis for reverse innovation or for 'glocalizing' similar products in affluent markets.

The recent fascination with frugal innovation or reverse innovation notwithstanding, this essay will argue that it is hardly an exogenous phenomenon that originated in the past decade. Indeed, Arrighi (2009) explains the changing behavior of MNEs by arguing that capitalism has historically moved from small containers to bigger containers as it seeks a spatial fix to overcome the periodic crises it faces. This movement used to be between countries that were relatively wealthy and with low population densities. Now the movement is to large civilisational states that have relatively poor and dense populations, such as China or India.

Section 2 will briefly trace the spatial fix over three industrial revolutions by showing how innovation and the development of new technologies, amid changing institutional conditions, have led to the pursuit of new markets. In particular, it will emphasise how, since the late 20th century, efforts to promote free markets and international trade to propel economic growth, combined with advances in information and communications technologies (ICTs), have fostered an informational capitalism that is organised around a global economy which operates as a unit in real time on a planetary scale (Castells 2000). In other words, this essay will situate frugal innovation and reverse innovation within long-term changes in technology, the organisation of production, demographic patterns, and public policy.

Yet, if there is a compelling argument to regard frugal innovation as endogenous to capitalism's evolution, it does not represent business as usual either. Understanding its approach to innovation, and its specific practices, which give a new socio-spatial character to capitalism, require, as Arrighi emphasises, new conceptual tools. This is because relying on frugal innovation to open up new markets, or on reverse innovation to operate more profitably in existing markets, is a risky proposition.

A critical issue is to identify lead users or markets which "provide the stimuli for most global products and processes for a multinational company. Local innovations in such markets become useful elsewhere as the environmental characteristics that stimulated such innovations diffuse to other locations" (Bartlett and Ghosal, 1990:243). In the words of Beisel (2004:998), "innovations that have been successful with local users in lead markets have a higher potential of becoming adopted world-wide than any other design preferred in other countries."

Hitherto, lead users have usually been sought in affluent and competitive economies, where consumers enjoy high per capita incomes, are used to technological innovation, and can evaluate alternatives in an environment with robust and reliable infrastructure (Bartlett and Ghosal 1990, Gerybadze and Reger 1999). Emerging markets, by contrast – which are home to the BoP, or the less poor – have rarely been chosen to launch new technologies. With their prior exposure to technologies limited to non-existent, new benchmarks are needed to

understand how such markets use new technologies in surroundings where illiteracy may be widespread and physical infrastructure, such as roads and power, inadequate (Aoyama and Parthasarathy, 2012).

The Economist (2009) points to three different approaches taken by firms pursuing frugal innovation. The first is to outsource production to lower-cost producers to take advantage of the specialisation that comes with a fine-grained division of labor.[2] A second approach is to use mass-production techniques for service delivery to reap economies of scale and scope.[3] But, despite the uncommon examples provided in footnotes 2 and 3, both approaches have long been deployed to reduce costs. A third approach calls for "imaginative use of technology". As an instance, *The Economist* points to the "elegant" design initiative, by the Indian software firm Tata Consulting Services, in the form of a box which uses the household television set to connect millions of Indians to the internet via the ubiquitous mobile phone. Unfortunately, terms such as "imaginative" and "elegant" are opaque and lack the analytical clarity of the two other approaches. The need to rely on such terms however only points to our limited understanding of frugal innovation and takes us back to the role of lead markets.

Innovation has typically been understood as a technology (scientific knowledge)-driven process, and tends to be measured either by supply-side factor inputs (technical labour force) or by outcomes (patent applications) (Aoyama and Parthasarathy, 2012). How demand-side knowledge is incorporated into the process of innovation and product development is under-theorised. This is despite a longstanding literature on producer-user interactions (for instance, Lundvall, 1988) and user-led innovation (for instance, von Hippel, 2005). Management scholars too, for instance, Porter (1990), have recognised the role of the consumer in innovation. But to the extent that literature on user-producer interactions exists, it largely assumes that users are known and specified –which can hardly be claimed of the lead users and markets being sought for frugal innovation. Even when there is a familiarity with users, geographers have emphasised the importance of what Polanyi (2009) termed tacit knowledge, and the importance of "learning by interacting" which comes only with physical presence in a place (Gertler, 2003): thus the critical role of proximity to lead users and markets.

Against this backdrop, Section 3 will make a second argument about frugal innovation: that it is manifesting itself in a changing *geography* of innovation, as the "triadisation" of innovation – i.e., investment in research and innovation that was limited to Europe, Japan and North America (Archibugi and Iammarino, 1999) – gives way to greater investments in emerging markets. There are two aspects to this geographic shift. One is the attempt by firms from emerging markets to broaden the scope of their activities from manufacture or service provision to innovation for their home markets and beyond. Another, which is the focus of this essay, is the attempt by MNEs from affluent countries to broaden their innovation efforts beyond the triad to include emerging markets.

Section 3 will highlight the changing geography of innovation by drawing on examples from India which has emerged as a prominent centre for such efforts, especially for MNEs from the triad. While there are, in theory, many locations where such MNEs could acquaint themselves with the BoP market, India is sought after because it has a large population that is poor and illiterate, living amid great socio-cultural diversity and inadequate infrastructure.[4] Although such circumstances, an unpredictable regulatory environment and the corruption in public life, can prove chaotic and challenge firms, it only leads Venkatesan (2013) to proclaim "win in India, win everywhere". The essay will draw from published sources and, in part,

from interviews conducted as part of an ongoing research project.[5] The essay concludes by reiterating how frugal innovation and reverse innovation represent continuity in their quest for new and profitable markets, even while giving new socio-spatial characteristics to capitalism.

The historical specificity of frugal innovation

To discuss the spatio-temporal context for frugal and reverse innovation, it will be useful to go back to a time when such terms were neither in vogue nor, perhaps, even significant. Until 1400, China was the world's leading technological civilisation, having mastered such processes as silk and gunpowder manufacture, and paper-making and printing (Mokyr, 1990).

But technological leadership shifted with the European enlightenment and the rise of modern science. While a scientific understanding of the world is critical to bring about technological change and industrialisation, just as critical are the institutional conditions. At least in Western Europe, these conditions manifest themselves with the replacement of feudalism by capitalism as the dominant mode of production (Anderson, 1974). Thus it was the capitalist mode of production with the scientific mode of enquiry that led to the industrial revolution from the late 18th century. The industrial revolution deployed new technologies to replace artisanal or craft production with mass production. Mass production needed large quantities of raw materials. It also required mass markets to valorise the production. The court or the landed gentry could no longer provide adequate demand.

The first industrial revolution, which ran roughly from the late 18th to the late 19th centuries, centered on Britain and was based on steam power along with technologies such as automated textile machinery, railways and the telegraph. The first industrial revolution solved the problem of markets with colonialism: thus, Lenin (1939) referred to imperialism as the "highest stage" of capitalism. In this stage, capitalist economic activity was characterised by production monopolies and a concentration of finance capital in banks. Colonialism brought much of the noncapitalist world under the control of international capital and locked colonies as destinations for goods and capital, besides incorporating them into the international division of labor as suppliers of raw material.

The second industrial revolution, which extended roughly from the late 19th to the late 20th centuries, centered on the Ruhr Valley in Europe and the mid-western region of the United States. It was based on electric power along with technologies such as the internal combustion engine, flight, and petroleum refining. During this industrial revolution, colonialism began to run out as an option for new sources of raw material and markets. By the late 19th century, many Latin American colonies began to break away from their colonisers, with Asian and African countries following in the 20th century. Thus, at least to cultivate mass markets, there emerged Fordism and the welfare state – a tripartite arrangement between the state, labour and capital.[6]

Fordism was characterised by mass production in vertically integrated firms. Mass markets were created as capital and labour (unions) reached a pact under which capital was given control of the work process to ensure steady productivity gains. In return, labour was

guaranteed wage increases which, in turn, sustained mass markets. The labour process was itself divided, between skilled workers in charge of conception, and unskilled workers on the production lines, with well-defined tasks. The Keynesian welfare state also played a key distributive role – it mediated between capital and labour, provided the macroeconomic policies to maintain a balance between productivity and wages, and supplied inputs such as education and health to ensure sustained productivity increases.

If Fordism and the welfare state led to economic prosperity in the advanced industrial countries, especially after World War II, most colonies and former colonies continued to serve as little more than sources of raw materials. This led to arguments from scholars of the dependency school, such as Frank (1967), who drew from the experiences of Latin America, about underdevelopment due to unequal terms of trade – i.e., the exchange of raw materials for manufactured goods. Political independence did not alter this state of affairs since the interests of the dominant classes in the former colonies, or the global South, were closely tied with those in the industrial North.

There was also an epistemic dimension to the critique, with the growth in the offshoring of low-skill, low value-added manufacture from the 1960s to create a "new international division of labour" (NIDL) (Frobel *et al*, 1980). Critics argued that the knowledge underlying technology and production continued to lie with the North and that, for the South, the NIDL only resulted in "bloody Taylorisation," (Lipietz, 1982) or the repetitive performance of unskilled tasks under repressive conditions, as the interests of capital from the North fit with the agenda of Southern elites seeking to exploit their comparative advantage in inexpensive labour. Yet, the arguments of the dependency school, and the NIDL theorists, were undermined with growing evidence, especially from East Asia, about the possibilities of "late-industrialisation" (Amsden, 1989; Evan, 1995). Countries such as South Korea and Taiwan learned to use borrowed technologies to move beyond low value-added production and substantially improve their standards of living. As Haggard (1990) succinctly put it, there were "pathways from the periphery".

Not all paths that were tried proved effective. For instance, under the influence of the ideas of Gandhi and Schumacher (1973), efforts were made to break away from technological dependence on the North by developing "appropriate" technologies for the South. However, appropriate technologies which de-emphasised automation, scale, and capital intensity, in favour of local control, decentralization, labour-intensity and energy-efficiency, did not gain wide acceptance. Among the reasons was their limited technical transferability, weak institutional support including insufficient funding, the challenges of distance and time in tackling rural poverty, and a perception that they were technologically inferior (Zelenika and Pearce, 2011).

Dependency analysis also did not fully apply to a group of countries which had withdrawn substantially from the world economy in favour of autarkic import substitution-led industrialisation policies. Independent India was a case in point (Sridharan, 1996). But when India started to liberalise and globalise its economy from the 1980s, acknowledging that it had not enjoyed the economic prosperity of its East Asian counterparts,[7] the world was changing.

A micro-electronics based revolution in ICTs was triggered in 1949 with the development of the transistor. It blossomed most prominently in Silicon Valley in northern California, with the development of the microprocessor in 1971, followed by the personal computer later that decade, and the commercialisation of the internet in 1993 (Parthasarathy and Lage 2010). As ICTs have become increasingly powerful, affordable, and versatile, their

revolutionary nature has led to convergence, with software increasingly determining the cost and functional characteristics of all semiconductor-based equipment, whether computers, telephone switches or audio systems. It has also meant that ICT is now no more than a broad and fuzzy term that refers to everything from the technology itself, whether hardware or software, to its use for digitisation and information processing in fields as distinct as banking, design, and medicine.

This new industrial revolution too had to find new market opportunities as a fiscal crisis enveloped welfare states from the 1970s, with rising costs of redistribution and sluggish economic conditions, made more acute by the growing competition from East Asia (Castells, 2000). The crisis in the welfare states of the North, and the disappointing economic record in much of the South (such as in India), created the conditions for the ideological ascendance of the "Washington consensus". The ideology was so called because of its promotion by the World Bank and the International Monetary Fund, which set aside statist developmental approaches in favour of free markets, private property and individual incentives, and the liberalisation of external trade and capital movements (Gore, 2000). One consequence of this shift was the push for an open international trading regime that was institutionalised in the form of the World Trade Organisation (WTO). The new trade regime was simultaneously facilitated by ICTs and, as mentioned in the introduction, laid the basis for an informational capitalism organised around a global economy (Castells 2000).

ICTs, India and the context for frugal innovation

The new institutional conditions, and ICTs-enabled digitisation, triggered the globalisation of services. As skills were in short supply in the triad, there was a wave of offshoring to locations where they were available plentifully and inexpensively. At this point India began to provide skilled software professionals and went on to become the largest exporter of software services in the world (Parthasarathy, 2010).[8]

This mutual embrace between India and the world has taken place in three phases. In the first, firms and customers from the North came to India exclusively seeking low-wage, even if relatively high-skill (in comparison with manufacturing) labour, for low value-added services to *support* design, development and production in the North. In the second phase, from the mid-1990s, the skills in India were used not only for low value-added services but increasingly to *develop* products and services for markets in the North.

As India's economic growth in the 1990s raised Indian consumers' purchasing power, the domestic market became increasingly attractive, especially where its needs could be met by existing offerings developed for markets elsewhere. But this market, i.e., an ambiguously defined middle class with consumption patterns similar to the North, is only a small percentage of the population in a country like India. Although some have claimed India's middle class is as large as 250 million, more sober estimates suggest that perhaps only 50 million have the disposable income that gives them the purchasing power of the middle class in the North.[9] As the limits of this market came to be recognised, discussion turned increasingly to the opportunities offered by the BoP and shaped the characteristics of a third phase. Below are three examples of how MNEs have used India's socio-cultural diversity, the BoP population, and its pool of skills to undertake frugal and reverse innovation.

GE Health Care has been present in India since the 1960s, mostly selling products from affluent markets, rather than making what Indian customers needed. The firm started local manufacturing in 1990 to reduce costs, but it was not until 2007 that it introduced a product that was conceptualised, designed and made in India for India.[10] This was the Mac 400, a portable, lightweight electrocardiogram (ECG), which was priced at US$800 when other ECGs cost at least US$2000 (*The Economist*, 2010). To make it easy to service (especially in remote areas) and to lower costs, the Mac 400 was designed with commercially available components, such as printers commonly found in portable ticket machines, instead of proprietary parts. This design approach also reduced the Mac 400's size so that it fitted into a backpack, and lowered its power consumption so that it could run on batteries as well as on grid power. Cost and functional advantages meant that the Mac 400 not only catered to existing markets but opened new ones as well. For instance, they allowed the product to move from the practices of cardiologists to those of general physicians. By 2010, GE had sold 7500 Mac 400s, of which only 2000 were in India. When the product was unveiled at the Medica trade fair in Germany in 2010, it aroused enough interest that 500 units were soon on their way from India to Germany (Irani, 2010).

In 2010, GE developed the Mac i (for India) at the half the price of the Mac 400. The Mac i met various international standards and incorporated the decision-support systems available on more expensive models to mitigate concerns about equality and reliability.[11] GE then went on to develop more advanced versions, such as the Mac 600, Mac 800 and Mac 1200. All these models added more features to cater to a wider range of users, including hospitals and clinics, while remaining portable and requiring minimal training to use, to ensure access for hard-to-reach patients.

Another US MNE, Microsoft, established a Microsoft Research (MSR) laboratory in Bangalore in 2005. The Bangalore laboratory is home to a Technology for Emerging Markets group, which has no equivalent in any of the other 12 MSR laboratories across the world.[12] This group of technologists and social scientists works closely with various external partners, including non-governmental organizations, universities, government, and private firms, to focus on communities that are increasingly consuming computing technologies and services but for whom computing remains largely out of reach. One result has been in education.

Studies of the use of personal computers (PCs) in rural Indian schools revealed high ratios of students to PCs – rendering the notion of a *personal* computer meaningless.[13] Researchers observed many children typically crowded around one PC, with one child dominating interaction with the machine, which limited the learning opportunities for the others. To increase interactivity with the PC for all children huddled around it, MSR came up with the idea of a multipoint mouse, or multiple mice with multiple cursors, for a single machine. It thus became possible for at least half a dozen children to share a PC at a fraction of the cost of acquiring PCs for all. The multipoint mouse went well beyond cost saving, as studies showed that the learning outcomes from its use in competitive and collaborative lessons could be as effective as those with one PC for each child. Microsoft's founder, Bill Gates, referred to the multipoint mouse as an instance of "creative capitalism" where firms design products and services for the demands generated by emerging markets. Microsoft's Education Products group eventually devised a software development kit which allows pedagogic material to be written on a single PC for up to 25 users. Together, the cost savings and collective learning benefits led to the deployment of the multipoint mouse in many countries.

A third US MNE provides another instance of contextual innovation, resulting from weak infrastructure.[14] Indian street addresses often do not follow a uniform system, and contain

phrases such as “opposite to” or “next to”. An address can, therefore, be written in several different ways. Software developed for places where addresses are more systematic can fail in India. The same person opening, say, two bank accounts from the same location will be recognised as two different persons if the addresses are written differently. As a result, firms attempting to cross-sell their products can offer the same product more than once to the same customers and risk double-counting them. The MNE realised the problem of inadequate business intelligence across databases and brought together a group of researcherswith an understanding of language technologies and unstructured information to solve the problem. Since non-standard addressing systems are also found in many emerging markets, the MNE integrated the solution into its products that are now available globally.

Conclusion

This essay examines the significance of the practices of frugal innovation and reverse innovation. It argues that these practices are spatially and temporally specific outcomes within a conjunction of long-run changes in technologies and the organisation of production, demographic pressures, and shifts in public policy. In other words, this essay highlights why frugal innovation and reverse innovation are not exogenous phenomena but are best understood as outcomes of the evolutionary logic of capitalism. At the same time, these phenomena are new to the extent that they represent changes to the socio-spatial characteristics of capitalism as evident in new geographies and new consumers.

Frugal innovation embodies historical continuity as it represents just another phase in capitalism’s quest for new markets. The current quest has been driven in part by demographic changes and market saturation in affluent markets. It is also being driven by new institutional conditions over the past quarter century that have emphasised free markets, private property and individual incentives, and the liberalisation of external trade and capital movements. Facilitating these institutional changes, and helping create a global economy, are increasingly powerful general-purpose ICTs, which are being deployed for digitisation and information processing in various domains.

But catering to the underprivileged is not easy, either technically or organisationally. Most emerging markets are home to the poorest segments of the world’s population which hitherto have rarely been considered in the conception of new technologies. Since prior exposure to technologies is limited to non-existent, understanding how these markets may use new technologies requires specifying new benchmarks in contexts where illiteracy tends to be common and physical infrastructure inadequate. Such circumstances require new approaches to innovation. With access to a new category of lead users becoming critical, and understanding users having a significantly sticky, tacit component, MNEs from the triad are forced to innovate away from their home countries.

As the geography of innovation has shifted, India has become an attractive location for frugal innovation and, by extension, reverse innovation. India is sought after because it has a large population that is poor and illiterate living amid great socio-cultural diversity and shabby infrastructure. Although these circumstances are also accompanied by an unpredictable regulatory environment and corruption in public life, India remains attractive because of its skilled labour which has made the country the largest exporter of software services. Thus, as the examples in Section 3 show, MNEs are using India to understand and solve the problems

of the BoP in domains such as health, education, and infrastructure. Solutions developed in India are finding their way both to the affluent world and to other emerging markets.

There is a historical irony in the use of three US MNEs as examples to illustrate the changing world of innovation. In 1975, the then US Ambassador to India, Daniel Patrick Moynihan, commenting on the implications of Prime Minister Indira Gandhi's decision to impose a state of emergency, said: "When India ceased to be a democracy, our actual interest there just plummeted. I mean, what it does it export but communicable disease?" (cited in Kux, 2002:337). Since Moynihan made his acid remark, the two largest democracies have found many shared interests. Sadly, what has not changed in India is the prevalence of many communicable diseases. However, with changes in the characteristics of capitalism, and India's position within the international division of labour, it is the prevalence of disease that is drawing many MNEs to make the country a centre of innovation, and it is the solutions to disease that are gaining prominence as exports rather than the diseases themselves.

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Footnotes

1. http://blogs.hbr.org/cs/2012/07/frugal_innovation_lessons_from.html (last accessed 23 August 2013)
2. The example used is Bharti Airtel, a telecoms service provider which offers among the lowest calling rates in the world and yet maintains operating margins that compare favourably with western counterparts. Bharti Airtel does this balancing act with a pioneering "managed services" model in which it focuses exclusively on providing telecom services to the end customer, leaving the design, management, and maintenance of the network to vendors, such as IBM, Ericsson or Nokia Siemens, who are paid on the basis of the traffic handled, and performance and service indicators.
3. The efforts of the Bangalore-based cardiac surgeon Dr Devi Shetty represent this approach to frugal innovation. Dr Shetty and his team at Narayana Hrudayalaya, a 1000-bed cardiac hospital (in comparison with the average of 160 beds in cardiac hospitals in the United States), perform surgeries with a success rate that is comparable to the US at barely a tenth of the cost. Yet, the privately run, family-owned, hospital group reports a 7.7% profit after taxes, compared with an average of 6.9% in private US hospitals. Economies of scale are also achieved by widening the pool of patients that the hospital can serve. The hospital has sliding fees so that wealthier patients subsidise poorer patients. Further, poor patients are also drawn by a low-cost health insurance

scheme that is promoted through rural local self-help groups. In addition, the hospital reaps scope economies by sharing laboratory facilities and a blood bank with a 1400-bed cancer hospital and a 300-bed ophthalmology hospital that it has established next door.

4. According to UNDP (2013), India's Human Development Index ranked 136 among 186 countries. The number of people earning less than $1.25 a day (purchasing power parity) was 32.7%, and only 62.8% of adults (15 years and older) were literate as against the world figure of 81.3%.

5. The research is being conducted with Professor Yuko Aoyama of Clark University, US, with financial support from a US National Science Foundation grant (BCS-1127329). Thanks are to Dr Niveditha Menon of the International Institute of Information Technology, Bangalore, for her assistance with the research for this essay.

6. This is the perspective of the Regulation School, which sees capitalism as going through different phases of regulation. Each phase is characterised by a regime of accumulation, or a pattern of economic activity, and a mode of regulation or a set of institutions governing the regime of accumulation. While this and the next paragraph provide the gist of the ideas of the Regulationists, there are many schools of Regulation. For a description of the different schools, see Jessop (1990).

7. India's relatively slow economic growth created a vast informal sector and encouraged widespread *jugaad*, Hindi for local improvisation. Recently, *jugaad* has received much attention and has been celebrated as reflecting Indian ingenuity in meeting needs amidst scarcity (see, for instance, Radjou *et al*, 2012). However, in contrast to innovations in the formal sector, the origins of grassroots innovations mean that their diffusion, whether for commercial ends or otherwise, face significant challenges including high transaction costs for scouting and documentation, the need for value-addition and finance, and ambiguous intellectual property rights (Dutz, 2007).

8. Despite the relatively low levels of literacy, post-independence India managed to train a large number of engineers. The annual output of graduates with a bachelor's degree in engineering grew from 247 at the time of independence in 1947 to 237,000 in 2006 (Banerjee and Muley, 2009: 9). The corresponding figure for the United States in 2006 was 104,200 (*ibid*.: 31).

9. See Mustafi (2013) and his blog on the Indian middle class in *The New York Times*.

10. Unless otherwise mentioned, this example draws from http://knowledge.wharton.upenn.edu/article/ reverse-innovation-ge-makes-india-a-lab-for-global-markets/ (last accessed 23 February 2014).

11. For details of the Mac family of ECGs, see http://www3.gehealthcare.in/en/Products/Categories/ Diagnostic_ ECG (last accessed 23 February 2014).

12. Details of MSR are from http://research.microsoft.com/en-us/labs/india/ (last accessed 23 February 2014)

13. Details of this example draw from http://blogs.msdn.com/b/multipoint/archive/2008/11/06/the-birth-of-multipoint.aspx and http://research.microsoft.com/en-us/um/india/projects/ edulab/ multipoint.html (last accessed 23 February 2014).

14. This example draws from an interview with a Vice President of the MNE, 28 June 2012, Bangalore.

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