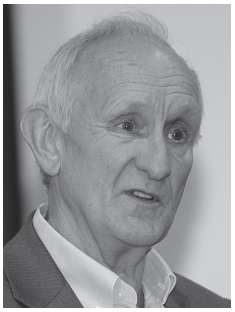
‘Jumping the tracks’: Crisis-driven social innovation and the development of novel trajectories



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Disruptive Innovation, Nutzer-Innovation, Open Innovation, bereichsüberschreitendes Lernen, Innovation im Gesundheitssektor, Innovation im humanitären Sektor

Disruptive innovation, user led innovation, open innovation, cross-sector learning, health care innovation, humanitarian innovation

Dieser Beitrag analysiert, wie unter dem Einfluss von Krisen, neue Wege für Innovationen geschaffen werden, die wiederum radikale Innovationen ermöglichen. Anhand von zahlreichen Beispielen aus dem Gesundheitswesen und dem humanitären Sektor wird gezeigt, wie extreme Krisenbedingungen die Suche nach neuen Lösungsansätzen erfordern, die wiederum signifikante Leistungssprünge mit sich bringen können. In diesem Kontext gewinnen unternehmerische Akteure als Vermittler zwischen den Welten besondere Bedeutung. Die Integration der Nutzer in den Prozess des gemeinsamen Gestaltens ist ebenfalls zentral; denn radikale Innovationen entstehen gerade kontextspezifisch und erst der regelmässige Austausch mit Nutzern formt die dabei entstehende Struktur so, dass eine rasche und breitgefächerte Verbreitung ermöglicht wird. Der Beitrag schliesst mit einer Diskussion der Herausforderungen, die diese Form der „reverse innovation“ mit sich bringt und mit der etablierte Unternehmen nur schwer umgehen können – beispielsweise aufgrund des „not-invented-here“-Syndroms.

This paper explores the role which crisis conditions play in shaping new innovation trajectories and enabling radical innovation. Drawing on a series of case examples from the health and humanitarian sector, it shows how the experience of extreme conditions forces the search for new solutions which can bring significant performance improvements. Within this context the role of entrepreneurs as brokers, connecting together different worlds, is of particular importance. User involvement in a process of co-evolution is also highly relevant; such radical innovation systems emerge from a specific context and it is the regular interaction with users which shapes the emergent model in such a way as to permit rapid and widespread diffusion. We conclude with a discussion of the challenges posed by such modes as reverse and potentially disruptive innovations which established ‘mainstream’ organisations find difficult to accept or adopt – the ‘not invented here’ effect.

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1. Introduction

Social innovation – innovation for the greater good – has a long tradition, with examples dating back to some of the great social reformers. For example, in the UK the strong Quaker values held by key entrepreneurial figures like *George Cadbury* led to innovations in social housing, community development and education as well as in the factories which they organized and managed (*Hirst* 2002). As *Mulgan* and colleagues point out 'The great wave of industrialization and urbanization in the nineteenth century was accompanied by an extraordinary upsurge of social enterprise and innovation: mutual self-help, microcredit, building societies, cooperatives, trade unions' (*Mulgan* 2007).

The tradition continues with a growing recognition of the importance of social entrepreneurship and an understanding of the underlying business models which can support the generation of sufficient returns to make a social enterprise sustainable in the long term (*Murray/Caulier-Grice et al.* 2010). Infrastructure investments – like the newly-announced Big Society Capital fund in the UK and specialist venture funds like Acumen in the USA – provide an alternative source of capital, and co-ordinating agencies – like the Young Foundation – provide further support for the mobilization and institutionalization of social innovation. The literature on entrepreneurship increasingly recognizes the motivational and identity characteristics behind social entrepreneurs and their desire to make a difference rather than a fortune (*Gruber/Fauchart* 2011).

That social innovation takes place is well-documented; of more significance is a focus on the *nature* of innovation which emerges from this process. *Ramalingam* and colleagues suggest that social innovation involves three specific elements:

- Social innovations are usually new combinations or hybrids of existing elements, rather than being wholly new in themselves.
- Implementing them involves cutting across organisational, sectoral or disciplinary boundaries. They create new social relationships between previously separate individuals and groups, contributing to the diffusion and embedding of the innovation, and increasing potential for further innovations.
- Social innovation is also seen as building on the inherent capacities of individuals and communities, which makes the notion of open innovation especially relevant (*Ramalingam/Scriven et al.* 2010).

Social innovations often arise out of a combination of widespread and often urgent need and severe resource limitations; they represent the preconditions for what can be termed 'crisis driven innovation' (CDI). Existing solutions may not be viable in such situations for a number of reasons including (relatively) high cost, lack of entrepreneurial return, technological inappropriateness (e.g. lack of skills base to support and maintain), etc. Instead, new solutions emerge which are better suited to the extreme conditions; the process requires rethinking and recombination in creative ways and can be the crucible out of which novel innovation trajectories emerge (*Dees* 2009).

Meeting the needs of a different group with very different characteristics to those of the mainstream population corresponds to what *von Hippel* terms 'extreme user' innovation (*von Hippel* 2005). He sees this space as providing a laboratory for the emergence of innovations which may well diffuse later to the wider population. Extreme users in his terms are active experimenters, tolerant of failure because of the learning implicit in the experimental process. Learning under these conditions provides opportunities for the emergence

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of novel innovation trajectories; significantly these may develop to become disruptive innovations as they begin to challenge mainstream dominant models (*Christensen* 1997).

In this process what starts as a set of experiments at the fringe can evolve into new pathways which eventually become a new dominant logic or dominant design. For example, the emergence of what has come to be known as 'lean' thinking applied in manufacturing and services goes back to crisis conditions within post-war Japanese industry (*Womack/Jones* 2005). Faced with serious resource limitations in energy, raw materials and crucially human capital, factories were unable to exploit the dominant trajectory of mass production. Instead they experimented around low resource usage models – lean is essentially a systematic attack on waste reduction in its many forms – and evolved over several years an alternative approach (*Monden* 1983).

Significantly this was not a single radical breakthrough but rather a reconfiguration of existing elements and their assembly into an alternative manufacturing system which delivered significant productivity gains whilst operating on a much lower resource utilization basis. Constituent tools like 'just-in-time' logistics, set-up time reduction, kanban inventory management systems, total quality management and total preventive maintenance were all different resources brought into play to deliver the compelling vision of a low waste approach necessitated by crisis. The subsequent diffusion of these ideas beyond their original birthplace highlights a key aspect of CDI; it often involves innovation at a system level and has widespread application potential as a result.

Examples of the conditions under CDI emerges include the need to meet widespread demand for healthcare, education, sanitation, energy and food across populations which do not have the disposable income to purchase these goods and services via conventional routes. As *Christensen* and colleagues have shown, working with unserved or underserved markets provides a crucible from which radically different solutions can emerge (*Christensen* 1997; *Ulwick* 2005). These are not necessarily pushing the technological frontier – in many cases they represent a simplification, a 'no frills' variant of an existing offer – but they have radically different price/performance characteristics which make them attractive not only in their original context but in the wider mainstream population. The so-called 'bottom of the pyramid' challenge is increasingly seen as a significant innovation opportunity of this kind, driving radically different approaches to meeting social needs (*Prahalad* 2006). Examples include Grameen Bank (banking productivity CLIC) and Visionspring (retail productivity/supply chain).

Humanitarian emergencies – such as earthquakes, tsunami, flood and drought, or man-made crises such as war and the consequent refugee problems – provide another example of urgent and widespread need which cannot be met through conventional routes. Instead agencies working in this space are characterized by high rates of innovation, often improvising solutions which can then be shared across other agencies and provide radically different routes to innovation in logistics, communication and healthcare (*Ramalingam/Scriven et al.* 2010).

In this paper we look in more detail at some examples of CDI and draw out some common features of this kind of innovation. We suggest that the reframing involved in CDI drives an active search and experimentation agenda which pushes into novel territory and has the potential for change at a systems level – 'architectural' rather than component level innovation (*Henderson/Clark* 1990). Of central importance in the process is an open innovation approach, casting the net for new ideas widely and in particular across different

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sectors with analogous problems. Within this context the role of entrepreneurs as brokers, connecting together different worlds, is of particular importance. User involvement in a process of co-evolution is also highly relevant; such radical innovation systems emerge from a specific context and it is the regular interaction with users which shapes the emergent model in such a way as to permit rapid and widespread diffusion. We conclude with a discussion of the challenges posed by such modes as reverse and potentially disruptive innovations which established 'mainstream' organizations find difficult to accept or adopt – the 'not invented here' effect.

1.1. Examples of CDI

It will be useful to begin by looking more closely at some examples of CDI and the ways in which system-level solutions based on alternative architectures have emerged which offer the potential to become novel and powerful alternative trajectories.

1.1.1. Aravind eye clinics

Whilst there are many complex optical disorders, cataracts are not generally regarded as a difficult challenge in eye care. Yet for nearly fifty million people around the world – nine million of whom are in India – cataracts mean blindness because they are unable to afford medical treatment. This has not only direct implications for quality of life, it also poses a significant threat to economic well-being since blindness may restrict employment opportunities. On retirement as Head of Opthalmology in a major Indian hospital, *Dr G. Venkataswamy* began exploring how to target and treat this group, using the simple tools and techniques which he and colleagues had worked with over many years.

This was not an insignificant problem – whilst the treatment itself – diagnosis, operation and after-care – is well-developed in the eye hospitals of the world, it comes at a price. In the USA, for example, treating cataracts costs between $2500 and $3000 and even in an Indian hospital the cost works out around $300. For a country like India where most people, especially in rural environments, earn less than $2/day such a price tag puts treatment out of reach. Meeting the needs of this segment is an example of what *C.K. Prahalad* calls, 'the bottom of the pyramid'.

That vision drove a programme of innovation and today the Aravind Eye Care System is the largest and most productive eye care facility in the world. In the year 2007/2008, about 2.4 million persons received outpatient eye care and over 285,000 underwent undergone eye surgeries at the Aravind Eye Hospitals at Madurai, Theni, Tirunelveli, Coimbatore and Puducherry.

Achieving this required extensive search outside the medical sector, looking at other fields with the same challenge of carrying out activities systematically, reproducibly and to a high quality standard – but at low cost. He found inspiration in McDonalds, the fast food company which pioneered an approach based on reproducibility – despite huge variations in the context in which they are located, all McDonalds outlets operate on the same model, and staff are trained in a core set of skills which are common to all its operations. This model, developed in the 1950s, was in turn borrowed from an earlier exponent, *Henry Ford*. He and his team of skilled engineers in the early 1900s faced the same challenge – how to make a complex product (the Model T Ford) systematically and reliably but at a low enough price that it could become 'a car for Everyman'? Their solution

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was to design a system which standardised as much of the process as possible and reduce the key skills and discretionary elements to a minimum – and then apply this across a high volume of production. In turn these ideas weren't new – the principles of division of labour go right back to the 18th century and the observations of *Adam Smith* on pin-making in the early days of the UK's factory system.

The basis of the Aravind eye clinics is standardisation and 'engineering' cataract surgery for high volume production. He opened his first hospital in 1977 with 30 beds and managed to generate a surplus in the first year of work so that a second 70 bed hospital could be opened catering exclusively to the poor and offering operations free of charge. In 1981 a fee-paying hospital with 250 beds was opened and another free hospital with 350 beds followed in 1984; by the turn of the century there were around 1500 beds (of which the majority were free) in Madurai. The model spread out to other locations across Tamil Nadu so that by 2003 there were five Aravind hospitals with a total of 3649 beds of which 2850 were free.

Just as Ford, McDonalds and Toyota focused on continuously improving and extending their system models, so the Aravind Eye Hospitals gradually shifted to become the Aravind Eye Care System. Key elements were added – for example, a dedicated factory for producing lenses, a training centre to provide key skills, specialist ophthalmic research centres, and an international eye bank. Of particular importance has been the Aravind Eye Camp model which takes the system out to rural locations, offering advice and diagnosis and feeding patients into the core hospitals where the high productivity model can treat them. This brings an element of preventive medicine into the system – by identifying early symptoms, particularly amongst children, relatively low cost measures (such as corrective glasses) can be implemented. There is now an extensive education programme linked to the camps which reaches out to rural communities.

Another important element in the system approach is the attention given to training to ensure an adequate supply of key skills. 900 ophthalmic assistants are taken on and trained each year to support the specialist doctors, whilst other skills such as counselling and education are also developed via dedicated training courses. Significantly recruitment and motivation are still strongly linked to the core values of *Dr V.* – there is a strong social welfare commitment which means that staff often work for less than they could earn in other parts of India's health system.

As with their earlier counterparts the success of the model relies on a process of continuous improvement directed towards a clear and sharp focus. Target costing is a well-known tool in product innovation for engineering the design of production systems, and in the case of the original cataract operation *Dr V.* set this as being around $50/operation (assuming no complications ensued). This compares to around $300 as an average cost for treatment in a conventional Indian hospital (and $1650 in a US hospital). Developing and refining the system has meant that the average cost in the Aravind system is $25, based on a proportion of patients paying between $50 and $300 but over 60% being treated free. In 2003 Aravind became the largest single cataract surgery provider in the world. The key is in the volumes – around 200,000 patients are treated each year, based on the high volume/low margin kind of business model which *Henry Ford* used on the Model T and which now drives the low cost airline industry.

Inevitably the approach involved rethinking the underlying model. In a conventional Western hospital an eye operation would typically take 30 minutes – yet the Aravind sys-

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tem needs only 10. This high productivity is achieved by significant process innovation driven by close analysis of value adding time. For example, each surgeon works on two operating tables alternately, and is supported by a team of paramedics to carry out less-skill dependent aspects such as washing the eye, putting in sutures, giving anesthetic injections etc. 70% of activities are carried out by a team of 4 nurses supporting the surgeon, 2 assisting directly and 2 acting as 'running nurses' bringing fresh instruments from the sterile area.

Of considerable importance is the fact that this low cost treatment is not provided by compromising on quality. A key statistic in medical care is infection rate – and the Aravind system actually has better performance than many Western hospitals. For instance in 2004 it was about 4 per 10,000 cases at Aravind, while the UK published rate was 6 per 10,000. (Interestingly the idea of having two patients in the same operating area is prohibited in many US hospitals because of fears of infection). Aravind also operate a very close outcome monitoring system, especially for cataract surgery, where every case sheet on discharge is fed into the computer and then analysed. In turn this feeds a continuous improvement process – measuring, reviewing and then changing. They put in a lot of effort to follow up on every camp patient and around 90% of the patients are interviewed as part of this process which provides valuable feedback on factors like outcomes of cataract surgery, the number of people recovering normal vision, intermediate vision and so on.

The same high volume/low margin model has been applied to hit target costings in other areas. For example early operations often involved fitting an 'intra-ocular lens' which was expensive as an imported product. Value engineering the design and then setting up manufacture within a division of Aravind – Aurolab – now means that the IOLs can be made for a fraction of the import price ($6 vs. $100-$150 for a US made lens of the same quality). In the process Aurolab have become a major producer with about 10% of the global market share.

But there is another important feature to this story. With such a high volume of surgery – 200,000 plus cases per year, with each doctor carrying out around 2,600 operations/year (against an Indian average of around 400) – comes a rich learning opportunity. The principles of the 'experience curve' have applied across many different industrial sectors – and there is no reason to suppose that healthcare is any different. Learning by doing is a powerful aid to developing robust systems – and in the Aravind case the model is now being looked at by many health authorities around the world.

1.1.2. LifeSpring Hospitals

As with the Aravind example the origins of this innovation lie in concern for a specific group of users who are marginalized from access to a key medical service – maternity and perinatal care – on the basis of cost. The problem of maternal mortality is significant; India has the highest rate of pregnancy-related deaths in the world, with around 117,000 per year (the Maternal Mortality Rate – the number of such deaths per 100,000 live births – is 540 whereas the US figure is 17). There is a high correlation with perinatal treatment; of the estimated 26 million births each year only 43% are supported by skilled staff.

Established in 2005 LifeSpring targets customers from a key tier in the Indian population, not the very bottom but low down the pyramid. Their customers are typically women whose husbands work in the informal sector, who have no health coverage and who

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are urban slum dwellers or in low income housing. The mission is to provide core maternal healthcare (antenatal and postnatal, normal and Caesarian deliveries, and family planning services) at an affordable price. LifeSpring also provides pediatric care (including immunizations), diagnostic and pharmacy services, and health care education to the communities in which its hospitals are located.

LifeSpring was set up as a joint venture between Hindustan Latex (a major manufacturer of contraceptives) and the Acumen Fund (a US-based social capital investor) and has treated more than 200,000 patients and delivered nearly 12,000 healthy babies since its inception in 2005. The model involves creating small – 20-25 bed – hospitals; the first broke even within 20 months and enabled the expansion of a chain of similar facilities via what has become a standard operating model. It maintains a tight focus, specializing in obstetrics, gynecology and pediatrics for women within a 10 km operating radius of their hospitals. Importantly the facility is designed for high throughout of 'standard' cases; women with complications are identified early and referred to other clinics. LifeSpring has become the largest chain of maternity hospitals in South India, treating more than 70,000 patients and delivering more than 7000 healthy babies each year; it now operates 12 hospitals in the Hyderabad area.

The hospitals are positioned as a low cost alternative to private clinics; there are some government facilities which offer lower cost (subsidized) treatment but these are oversubscribed and access is often difficult. Typically the charges for normal and Caesarian deliveries are 12% of private clinics; normal births cost around 1.5K rupees as against 8 to 10K and Caesarian figures are 6K as against 20-30K (Monitor_Group 2008).

Achieving these significant reductions has again involved a process of innovation against a clear focused target vision. Once more the basic principles of high volume standardized 'production' are central to this and there are clear similarities to the Aravind model. In particular LifeSpring's model is characterized by four 'pillars' which provide a focus around which a rage of innovations are grouped:

- Service specialization
- High throughput
- High asset utilization
- No frills service

(Significantly these are essentially the core principles of the low cost airline business model which has had such a disruptive effect in short-haul aviation).

Service specialization involves a high level of standardization around a tightly focused service offering. This allows for rapid replication and spread of the model – a 'drag and drop' approach. Importantly complications are screened out early and such patients are cross-referred to other specialized clinics. Operating protocols and procedures are standardized which allows for the rapid training of low-skilled staff and the replication of the model quickly into other situations. Standardized kits are used for a wide range of surgical and other procedures and the range of medications is kept low to reduce cost and increase purchasing leverage. Importantly a lower skill-grade of nurse – ANM as opposed to GNM[1] – is recruited; these nurses are trained internally in a narrow field and achieve a high level of competence. This helps retention whilst also reducing labour costs.

1 General Nursing and Midwifery and Auxiliary Nursing and Midwifery certification by the Indian Nursing Council.

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High throughput involves operating at a much higher volume (outpatient and deliveries) than traditional players, enabling LifeSpring to spread its fixed costs over a larger number of customers. In their hospitals they complete 100-120 deliveries per month compared to 30-40 in similarly sized hospitals. Making this model work depends on maintaining a consistent flow of patients. This is achieved by focusing on areas of high population density but also working with those communities to ensure widespread awareness. This is important in a sector with low literacy where word of mouth is the key communication channel and where trusted recommendation is of significance. LifeSpring operate through a 'sales force' working in the community and make use of education 'camps' and offer vouchers and baby packs to generate repeat business.

The 'no frills' element involves systematic focus on driving down costs through elimination of unnecessary and non-value-adding activity – essentially the principles of 'lean thinking' (*Womack/Jones* 1996). Medicines used are drawn from a narrow range and inventories are kept low through a just-in-time policy; pharmacy services are outsourced to reduce costs and also cut the risk of pilferage. The hospitals do not run their own ambulances and wards are general rather than specialized. Capital expenditure is reduced through renting space in old hospital premises and by working with a standard and limited set of equipment.

High asset utilization is achieved through deploying a cluster model; by setting up multiple small hospitals within a single city many key resources – ambulances, back-up facilities, etc. – can be shared. Of particular significance (since the main cost in prenatal care is in doctor's salaries) is the use of fixed salaries for doctors.

1.1.3. Narayana Hrudayalaya Hospitals (NHL)

As with the preceding examples, the NHL model began with a sharp focus on delivery of a specialized target to bottom of pyramid users. In this case the founder and visionary was *Devi Shetty* who originally trained as a cardiologist and whose vision was to bring cardiac care within reach of this group. More than 2 million Indians need, but cannot afford, heart surgery; in 2011 heart disease overtook communicable diseases as the major cause of death and this has significant knock-on economic effects since family breadwinners are often the victims. His first step was to establish a 150 bed hospital in Bengaluru in 2001 but this model has spread rapidly on the back of significant productivity gains. His NHL 'health city' complex now on the site is the world's largest and also the cheapest heart care institute. It includes the world's largest heart and cancer hospitals, a specialty hospital for all the plastic reconstructive surgery, an institute for organ transplant, a hospital and also training and research institutes.

The 1,000-bed heart facility provides high-quality yet very inexpensive heart surgery; in 2008 there were 3,174 cardiac bypass surgeries and 2,777 paediatric operations, more than twice the volumes achieved in leading specialized hospitals in the US. Their success rate is higher than that of their counterparts in New York State, and the mortality and hospital-acquired infection rates equal those of the best hospitals worldwide. The hospital reports a 7.7% port margin, higher than the average for US hospitals, but charges US $3,000 or less per surgery, compared with US$5,000-7,000 in private hospitals in India and up to US$50,000 in the US. With further changes in processes, negotiations with suppliers and creative partnerships, NHL plans to reduce its costs even further.

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Its significant improvements in productivity have come through systematic process innovation which has reduced the cost of a heart surgery to Rs 75,000 for a 3-4 day surgery and care. Large corporate hospital chains charge Rs 2.25 lakh or more for this. Similarly, because of scale in dialysis, prices are cheaper by 15-30%.

Once again the underlying principles are simple and would be recognized by *Henry Ford* or *Taichi Ohno* of Toyota – economies of scale achieved through standardization and linked to continuous and systematic improvement over time. For example, the pediatric cardiac unit is the largest facility in the world with around 50-60 cases undergoing treatment at any one time – probably, the number of cases that other hospitals would handle in a year. Such scale drives significant economies in key items of procurement of equipment drugs, and other consumables as well as allowing for more efficient utilization of human resources. (For example, NHL is currently the largest customer for heart valves in the world).

Central to the model is policy deployment – focusing on a core goal – cost reduction without compromising quality – but then recognizing the myriad ways in which that can be delivered by mobilizing high involvement innovation (*Bessant/Francis* 1999; *Bessant* 2003). Examples include cutting the cost of items like sutures and gloves by nearly 50% through a combination of incremental innovation and negotiations of volume discounts with suppliers. Careful attention to value and utilization has brought a sharp focus to innovation in equipment utilization; for example air conditioning is only deployed in areas where it is required for medical reasons, such as in operating theatres. (This 'value stream mapping' approach is a core component of lean thinking methodology (*Hines/Cousins et al.* 1999)).

Another theme recognizable in the manufacturing world is that of using simple low cost machinery as opposed to complex multi-function devices which carry higher capital and maintenance costs. Existing equipment is also supported through careful maintenance to extend its lifetime using approaches drawn from the 'total productive maintenance' experience in manufacturing (*Vaag* 2001).

Land and buildings are major components of hospital costs but NHL have managed to reduce these by concentrating on out of town sites which are cheaper and by partnering with government who provide subsidies in return for NHL treating a proportion of patients (typically 5%) at no cost. Another strategy is to take over 'failed' investments – such as a hotel – and re-use the facility; the conversion cost is considerably lower than purpose-building.

Human resource policies are another key component; where necessary NHL makes use of skilled doctors but for a wide range of activities it employs nurses and other staff. By training and specializing them NHL builds capacity and flexibility into the system. However non-core activities such as security or cleaning are outsourced. Cost savings also come from changing the relationship with doctors who concentrate their efforts in NHL hospitals in return for a high but fixed salary – as opposed to consulting with several hospitals. This means they do not waste time travelling between patients but also building experience and learning across established teams.

The scale of operation also allows for considerable learning effects; NHL carries out 10 times the volume of heart surgeries of other hospitals currently accounting for around 12% of all heart surgeries (90,000 p.a.). With such high volumes surgeons at NHL become more experienced; NHL currently has the best success rate of any cardiac

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hospital in the world. Similar patterns can be seen in other areas; for example NHL performs the maximum number of dialyses by any hospital chain in India and the Mazumdar Shaw Cancer Centre does the most bone marrow transplants.

As with LifeSpring the standardization of the core model makes it relatively easy to replicate and scale and in a period of just over 10 years NHL has expanded its operations to 11 cities with 14 hospitals and 5000 beds. The NHL chain is now the 4th largest in India and offers care across a number of treatment areas beyond cardiology; NHL now offers care in orthopaedics, oncology, nephrology, neurology, eye care, dermatology and dental care. It has even moved into cosmetic treatment such as rhinoplasty, liposuction and breast reduction or augmentation.

Of particular relevance in NHL is the idea of system level thinking. It is not just the direct medical care but innovation in the much wider system which makes this such a powerful model. Examples include close links with pharmaceutical firms who work with NHL on clinical trials and with equipment makers, who not only offer lower prices in return for guaranteed volumes but are also experimenting with new business models. For example, NHL has been able to convince equipment vendors to install machines and accept returns on a pay-per-use model since volumes of use are so much higher than conventional hospitals.

It has also been very active in developing the wider health infrastructure in India, for example through involvement with micro-insurance for bottom of pyramid citizens. *Shetty* pioneered the idea of the Yeshasvini medical insurance scheme which was originally targeted at the estimated 2.2 million farmers and peasants in the Karnataka region who were part of the Karnataka Milk Federation. (It has since been extended to a wider range for people across the region). Established in 2003, this scheme offers a comprehensive package covering surgery and associated out-patient care for an average cost of €2.2/year for adults and €1.2/year for children. Its viability is based on some simple principles; typically less than 0.8% of the population requires surgery and no-one willingly wants it; as a consequence fraud levels are very low.

As with the previous models the core goal of delivering low cost insurance is then supported by extensive innovation across the system to drive down costs through standardization of operating procedures, simplification of administration (for example, the farmer's co-operative is responsible for collecting payments, and the regional government allowed post offices to handle the issuing of membership cards) and improvements in resource utilization. The scheme concentrates on common types of surgery – 1,650 varieties – and also offers outpatient consultation pre and post surgery. To deliver it mobilizes a network of around 400 hospitals with under-utilized operating theatres (utilisation rates in the region can be as low as 35%); around 30,000 operations and 85,000 consultations were carried out during the first two years of the scheme's operation.

A recent evaluation of the scheme by health economists concluded that 'the programme is found to have increased utilisation of health-care services, reduced out-of-pocket spending, and ensured better health and economic outcomes…' (*Aggarwal* 2010). The scheme is self-funding although the government contributes a third of the 7.5 rupees premium.

NHL are also involved in hospital design since they are now a major customer for construction; in this way their influence on design-for-purpose can drive further economies and improvements in quality of service. NHL are also pioneering telemedicine approaches to extend the outreach and 'front-end' of the healthcare system. Through an extensive net-

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work of on-line consultations NHL can prepare for patients coming into its facilities and reduce in-house costs, duration of stay, etc. whilst enhancing the quality of care provided.

As with many social entrepreneurs there is a clear business vision – it is not simply a philanthropic charity or aid dependent system but a viable business model in which cross-subsidy takes place. Wealthier patients still receive cheaper care but the margin between actual delivery costs and selling price to them generates a surplus which can be used to help those least able to afford it. About 5 % of its patients (equivalent to 50-60 free surgeries/week) receive free treatment and an additional 27 % receive subsidized treatment.

NHL have already demonstrated the transferability of its standardized model; it can operate a 'drag and drop' approach and is now exploring moving beyond India with facilities in Malaysia. Of particular significance is another investment in the Cayman Islands where the aim is to tap into the neighbouring US market which is only an hour away. A 250-300 bed facility is being built which will cater for a growing segment of the population worried by spiraling US healthcare costs.

1.1.4. Alternative uses of mobile communications

Under extreme conditions – such as in the immediate aftermath of a disaster like an earthquake or tsunami – there is an urgent need to establish robust and reliable communication networks. Gathering information, processing it and making it available to those who need it to shape decisions about resource allocation, prioritising logistics and real-time status reporting are all key needs towards which innovation is targeted. Significant progress has been made by humanitarian agencies in learning to deal with this challenge by deploying information and communication technologies.

One of the powerful and high impact innovations in delivering aid in recent years has been the idea of providing cash to distressed populations rather than trying to distribute food aid (*Ramalingam/Scriven et al.* 2010). This has the advantage of providing relief whilst reducing transportation and distribution costs and also offers significant empowerment to recipient populations, reducing their sense of dependency. Whilst simple in concept it presents significant logistical and security issues but the use of mobile phone technology opens up major new opportunities in this space. For example, the aid agency Concern Worldwide (CW) pioneered the use of 'mobile money' to develop an emergency response programme in the post-election violence in Kenya in 2007. It included the distribution of mobile phones as enabling devices and was able to succeed because of a partnership with M-PESA, a powerful and robust platform which had been developed in Kenya to enable what is effectively mobile banking amongst low income groups.

In the chaos following the election 'normal' communication and information networks were disrupted which made it difficult for aid agencies to identify where their help might be needed – and when they arrived at a location their ability to co-ordinate logistics etc. was seriously compromised. CW identified a problem area in the remote Kerio valley area and began developing an emergency food programme working with local partners from the Catholic Diocese of Eldoret. However it quickly became clear that the remoteness of the location would make distributing food expensive – and there was a continuing security risk. Consequently the team began exploring an alternative cash distribution programme using M-PESA as an enabling platform.

The process involved distributing mobile phones and also working with M-PESA to facilitate the transfer of large amounts of money (M-PESA normally has a limit on size of

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transaction to prevent money laundering). Importantly it empowered local recipients to solve their own problems locally rather than encouraging dependence on traditional aid distribution. It proved successful according to independent evaluations which suggested around 70% of the money transferred to the region was spent on food and the remainder on transport and other non-food essentials. Whilst the programme was expensive in terms of the initial cost of the phones it provided a downstream and sustainable framework on which the supported communities could build.

Similar models for emergency aid have been used in other regions; for example CW used the approach in Niger where it was possible to conduct a randomized evaluation of the mobile-phone cash transfer programme compared with other options (*Aker/Boumnijel et al.* 2010). One third of the targeted villages received monthly cash transfers via Zap (the name given to the mobile phone approach), one third received manual transfers and one third received manual transfers and were also given a mobile phone. The results indicated that the Zap delivery mechanism strongly reduced the variable distribution costs for CW and also cut the costs for the recipients in obtaining the money. There were additional benefits; 'households in Zap villages had higher diet diversity, depleted fewer assets and grew more types of crops, especially marginal cash crops grown by women'.

The availability of an alternative communications platform based around mobile phones offers other opportunities in the humanitarian aid space. For example it can be used in crisis mapping – quickly collecting and collating diverse information to provide an accurate picture of what is happening and allow for co-coordinated responses. Again in the context of post-election violence in Kenya a scheme called Ushahidi (a word which means 'testimony' in Swahili) was developed which effectively mobilized a 'crowdsourcing' approach to collect and collate such information across various channels – Twitter, email, SMS and voice traffic (www.ushahidi.com). It enabled users to identify and provide alerts about specific problems and collated data allowed aid agencies to visualize a rapidly changing situation. Importantly such a model differs from conventional centralized collection and collation by deploying a decentralized network approach; variants on this have been used in many trouble spots around the world; the Ushahidi platform is easily transferable and allows aid agencies and others to set up fast and robust crisis mapping.

The original platform was developed by a group of Kenyan citizen journalists to map incidents of violence; it quickly grew to around 45,000 users and the team realized there was demand for this kind of tool in other applications. Ushahidi has been streamlined and simplified such that it can run on many devices and can be set up in minutes, accepting data submitted via phone, SMS, email, twitter, etc.; the 'Crowdmap' application allows users to set up a system within two minutes. Since 2008 it has been used widely, supported by a largely volunteer workforce, in contexts as varied as snow clearing after the Washington snow, emergency support after the Australian floods and disaster relief after the Haiti earthquake. Within two hours of the Japanese earthquake and tsunami a version of the platform was available to help locate where people were trapped, where food and water supplies were available, where transportation links were working or had been damaged, etc. (www.sinsai.info/ushahidi). Other non-emergency applications are now emerging – for example a Canadian site is using a version to crowdsource information about heritage buildings (www.thisplacematters.ca).

Another innovative application of mobile communications has been to create employment opportunities for disadvantaged groups using 'micro work' principles. 'Impact sourc-

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ing' is the term increasingly used to describe the use of advanced communication technologies to permit participation in global labour markets by disadvantaged groups. Increasingly many tasks – such as translation, proofreading, optical character recognition (OCR), cleanup or data entry- can be carried out using crowdsourcing approaches; Amazon's Mechanical Turk is extensively used in this fashion. Social entrepreneurs like *Leila Janah* saw the potential for applying this approach and her Samasource organization now provides employment for around 2000 people on very low incomes in rural areas.[2] The increasing availability of mobile communications allows for mobilizing and empowering this group and an increasing number of US high tech companies are sourcing work through her organization.

The model is not simply low cost outsourcing; through a network of local agencies Samasource not only provides direct employment opportunities but also training and development such that workers become better able to participate in the growing network of online knowledge work. Organizations like Samasource recognize the risk that the model could simply be used to exploit very low wage rate workers; their business model requires that partners employ people earning less than $3/day and reinvest 40% of revenues in training, salaries and community programmes.

There are similarities to microfinance; the underlying business model is essentially extending a well-known principle (business process outsourcing) to a new context – educated but marginalized people on low incomes who could play a role as knowledge workers. Samasource mobilizes people in a variety of countries and contexts including rural villages, urban slums and even refugee camps. The model is diffusing widely – other organizations such as DigitalDivideData[3] (originally established in S.E. Asia in 2001 and now employing nearly 1000 people in Cambodia, Laos and Kenya) and Crowdflower perform similar integrating roles, bringing disadvantaged groups into the online workforce.[4]

2. Key features of case studies

These cases share a number of features beyond their being impressive solutions to social and humanitarian needs. In particular they reinforce the view that such situations can provide a powerful learning laboratory for innovation and allow experimentation towards radical solutions. Importantly the crisis conditions mean that the repertoire of 'conventional' solutions is not viable and so a search for new solutions is triggered – essentially recreating the kind of 'fluid state' characterized by early sages of the innovation life cycle (*Abernathy/Utterback* 1975). Within this space entrepreneurial behaviour is important, experimenting and learning fast through failure and setback as much as success. It also places emphasis on the role of users in context who can help shape and configure innovations so that they are suitable for wider diffusion; the process is essentially one of co-evolution.

Solving problems within this context requires a wider search because conventional ones by definition are not appropriate. In this way CDI forces a high level of 'open innovation'; exploration of new insights and ideas across sectors is a key feature but the central theme in all of the above examples is one of what *Hargadon* (2003) calls 'recombinant' innova-

2 http://samasource.org/.
3 http://www.digitaldividedata.org/.
4 http://crowdflower.com/.

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tion. That is, solutions and techniques were widely available and proven in other contexts; the key contribution of the entrepreneurs was to bring them together in a new setting.

For example the core ideas underpinning the significant productivity gains in the Indian healthcare cases are essentially using core principles of the Ford/Taylor mass production system which were developed in the early part of the 20th century. In its turn this model was created by a synthesis of multiple and proven practices from several different industrial sectors – standardization of parts came from the gun industry, scientific method from the steel industry and the assembly line from ideas around disassembly in Chicago abattoirs. The principles of open innovation can be seen clearly in the development of mass production – and similarly in the emergence of lean thinking. In each case the process involves significant learning from different worlds and assimilation into an effective new system – and the role of entrepreneurs as brokers is critical to this.

Working in this way requires a reframing – redefining in context what is needed rather than making prior assumptions. By abstracting to the basics of the problem new insights about potential solutions emerge from other sectors – it can trigger novel search behaviour and cue attention to new stimuli. This process of reframing and abstraction also allows for a powerful rearrangement of the underlying system; and corresponds to what *Henderson* and *Clark* call 'architectural innovation' (*Henderson/Clark* 1990).

It is also important to recognize the process of learning and continuous improvement within this new architecture. In each case – as with earlier examples of system innovation like Ford's mass production factory or Toyota's lean model – the overarching vision provides the framework within which a process of continued and sustained incremental improvement can take place, mobilizing high levels of participation in the innovation process. Central to this is the principle of 'policy deployment' – hoshin kanri – which breaks down high level strategic targets into local level problems which can be solved by continuous incremental innovation (*Akao* 1991).

Putting in place robust mechanisms to enable experimentation and subsequent capture and sharing of learning is central to the development of a system which can be replicated. The underlying process is one which relies heavily on converting tacit knowledge to formally codified forms which become available for others to sue in what become standard operating procedures and eventually a standard operating model (*Nonaka* 1991).[5]

This codification into standard operating models is of key importance in allowing replication, diffusion and scaling of the new system – as we see in the NHL, Aravind and LifeSpring examples. In similar fashion the focus on innovation in humanitarian agencies involves a growing recognition of the need to share and capture lessons learning so that they are available as part of an emerging 'best practice' repertoire, learning and sharing about common problems and solutions allows for the building up of long-term capacity to deal with future problems – through institutionalizing lessons learned such as stockpiling, scenarios, rehearsal, etc. (*Ramalingam/Scriven et al.* 2010).

5 The UK supermarket chain Tesco uses a similar principle; it captures learning about supermarket operations and codifies them into a standard operating model (SOM) informally referred to as 'Tesco in a box'; this package can then be used to transfer to new locations in a 'drag and drop' manner. New learning from the new site is then developed and assimilated back into the SOM (*Michelle Lowe*).

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3. Working in new innovation space

We can map such innovation on a simple model as shown in *Figure 1*. The vertical axis corresponds to the familiar incremental/radical search which organizations undertake to develop improved or radically new solutions. But the horizontal relates to the framing of environmental elements (technological, market, social, regulatory, etc.) from which to seek out innovation options. Just as in human cognition organizations have limited attentional resources and so choose to frame world in particular ways so as to maximize their search efficiency (*Kahnemann* 1973). This framing is implicit in business models and the resulting innovation activity within such a frame gives rise to what different writers refer to as a 'dominant logic' (*Prahalad* 2004), 'technological trajectory' (*Dosi* 1982), or 'industry recipes' (*Spender* 1996).

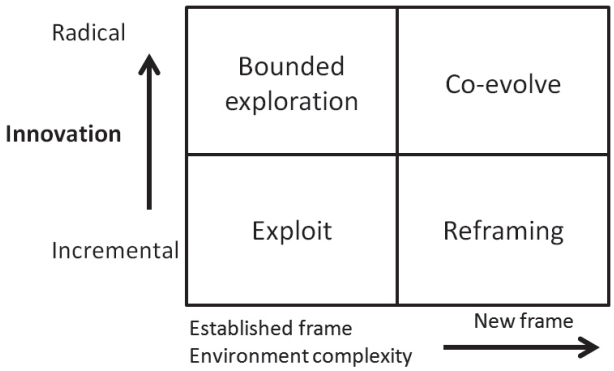

Figure 1: Framing innovation space for search behaviour (*Bessant/Von Stamm et al.* 2011)

Viewed in this way zones 1 and 2 on our model represent familiar territory in innovation literature, dealing with the 'exploit' and explore domains but assuming a bounded selection environment (*March* 1991). Within this space a set of solutions are identified and implemented and although there may be local and short-term advantages accruing to individual players as a result of early discovery, intellectual property protection, etc. the pattern of innovation becomes quickly shared across all players.

However alternative frames are possible, bringing in different elements – and this is very much the role of entrepreneurs identifying new space and opportunity on the map. As *Schumpeter* (1950) pointed out, the role of the entrepreneur is 'to reform or revolutionise the pattern of production' and, as *Rosenberg* and *Birdzell* (1986) point out '….new enterprises are useful devices for experimenting with innovation, because they can be established on a small, experimental scale at relatively low cost and therefore in large numbers, and their efforts can be intensely focused on a single target.' They have greater flexibility to experiment, uninhibited by the biases, standard operating procedures, bureaucracy, cultures, strategic commitments, and other rigidities common in established organizations of all kinds.

For example, low cost airline innovation was essentially a case of bringing in hitherto marginalized segments of the population – those who wanted to fly but were prevented from doing so by cost barriers. As *Ulwick*, *Christensen* and others have pointed out, working with the needs of such unserved or underserved markets provides a powerful op-

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portunity for disruptive innovation (*Ulwick* 2005; *Christensen/Anthony et al.* 2007). By definition meeting their needs will involve novel solutions, recombining elements in new configurations which are better suited and often doing so along a radically different price/performance trajectory.

Such solutions are unlikely to emerge in the context of zone 1 or 2 because of the framing problem outlined earlier. Similarly *Mohammed Yunus* set up Grameen bank, pioneering microfinance as a way of bringing banking services to an unserved section of the population. The model became successful, serving some 8 million people in Bangladesh and has been profitable since 1993; it has been widely replicated and microcredit schemes of this kind now support over 100 million families worldwide. Yet the original idea was rejected by the Bangladeshi government, the banks, the international relief agencies, and local business entrepreneurs.

In similar fashion recombination of technological elements – either by introducing a novel approach from elsewhere (e.g. mobile phone technology substituting for existing banking systems) or by using a simpler variant (GE's simple low cost ultrasound scanner for the rural market in emerging economies) – offers powerful new opportunities which may be disruptive. Entrepreneurs working in this space are dealing with a 'crisis' – meeting needs of an unserved or underserved group within characteristics which marginalize them from access to 'mainstream' solutions – for example, through cost. Developing simple, robust and lower-cost variants requires considerable ingenuity and highlights again the key role which an open innovation approach plays, with entrepreneurs borrowing and adapting ideas from many locations. The potential for such innovations to diffuse across the mainstream and disrupt markets is well known and we will return to this theme later.

As we approach zone 4 the nature of the innovation becomes more radical – not necessarily in terms of pushing the technological frontier but in terms of performance improvement. *Leifer* and colleagues (*Leifer/McDermott et al.* 2000) attempted to provide a metric for 'radical' suggesting that it involves:

- An entirely new set of performance features
- Improvements in known performance features of 5 times or greater
- A significant (30% or more) reduction in cost

Achieving this may involve a breakthrough along a particular trajectory but it can also involve a recombination into a new system whose emergent properties provide the radical gains. Examples here would be low cost flying – in which the basic technologies of flying did not change but the cost model was significantly shifted. Mass-producing motor cars again involved little technological breakthrough but rather a recombination of established elements into an alternative system which could deliver a low cost solution to a widespread need. And applying this definition we would certainly place Aravind, NHL and LifeSpring in that zone; although not employing radically new technology components they represent system level innovations which have major impact on productivity.

The process involves a challenging vision which requires a novel system-level view followed by a laborious process of reconfiguring a different architecture resulting from that root definition. Within the system framework the process involves recombination of different but established elements and a process of continuous improvement to move along the new trajectory.

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In complexity theory terms zone 4 is a space where multiple solutions are possible but it is impossible to predict which will emerge. The process of emergence is one of co-evolution, with amplification and feedback operating around possible nodes (attractor basins) and a gradual reinforcement of an emergent trajectory. Enabling such activity requires openness, flexibility, tolerance of ambiguity and failure, experimentation and fast learning – all within a context in which users are key to the shaping process. These characteristics are of course strongly associated with entrepreneurial behaviour but represent challenges to established organizations (*Tushman/O'Reilly* 1996; *Bessant/von Stamm et al.* 2010).

4. Enabling radical innovation – a process model for CDI

Table 1 draws together some of these core themes and suggests an emergent process model for enabling CDI with at least five key stages.

The crisis stage involves articulating a clear and focused vision which demands a novel response; existing trajectories are unable to deliver performance changes on the scale required. Examples of such high level vision include the US 'man on the moon', *Henry Ford's* idea of 'a car for Everyman at a price Everyman can afford', or the 'invisible aeroplane' which led *Lockheed-Martin* to develop stealth technology through its 'skunk works' team (*Rich/Janos* 1994). Such visions set stretch targets and force search behaviour in new directions; they also cue attentional responses to new signals rather than filtering them out. In the cases the ability to find a passionate entrepreneur at the centre may not be coincidence – their role is to have the vision but also the passion to infect others and bring them into the vision.[6]

Exploration of potential new directions involves the observatory stage, in which search behaviour is enabled in novel ways. This corresponds to open innovation search patterns and may well require brokerage, cross-sector linkages, working with users, foresight, ethnography and multiple other approaches (*Bessant/von Stamm* 2008). It often involves deliberate recruitment of 'outsiders' to bring alternative experience and perspectives; for example much of the later success of the Aravind model came through the engagement of *David Green* who brought considerable experience of low cost manufacturing models and helped establish the Aurolab network.[7]

It also requires the ability to abstract the core problem to a higher level such that potential solutions in other sectors/worlds can be perceived as relevant. For example the significant productivity improvements in machinery set-up in Japanese factories came in part from learning about pit stops in motor racing; in turn these ideas were adopted by low cost airlines seeking to reduce turnaround times at terminals, and hospitals looking to optimize operating theatre usage. Although very different in sectoral context the underlying process of changeover is the same (*Shingo* 1983; *Bessant* 2003).

The laboratory stage involves experimentation with the original idea to adapt it to the new context. By its nature this process involves failure and fast learning and user input is critical in shaping and configuring a robust solution. Whilst the initial idea may be radical its shaping and development involves integrating a wide range of small scale incremental

6 It is perhaps fanciful but interesting to note that the Chinese character for 'crisis' is a juxtaposition of the two characters representing 'threat' and 'opportunity'.

7 *David Green's* approach provides a system level example of low cost manufacturing and micro-franchsiing which enables employment at the bottom of the pyramid whilst also offering low cost solutions to key product and process needs like eyecare, hearing care or clean water.

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improvements in a process of experimentation, learning, capture and codification. Within the framework of a core vision such incremental experimentation can engage a large number of people in a process of policy deployment driven innovation – hoshin kanri[8] (*Bessant/Francis* 1999).

In the prototype stage there is further evidence of high user engagement and development of robust configurations which will actually work and be accepted. At this stage it is important to have a working model of the system level innovation which can act as a 'boundary object' demonstrating the operation and advantages of the new approach but also allowing input from potential adopters in further shaping and developing the ideas. For example *Shetty's* first hospital in Bangalore allowed a wide variety of people to see the potential and to add their insights into shaping the 'standard model' which was then replicated widely. In similar fashion the first Aravind eye clinic allowed for prototyping and learning but also provided a vehicle for engaging key players who could help in scaling up and diffusion.

Stage	Characteristic activity
Crisis	Creation of a driving entrepreneurial vision which simultaneously articulates the need for change and for radically different solution involving a new trajectory.
Observatory	Extensive search in novel directions to find relevant approaches which could be adapted – requires ability to abstract problem and solution thinking to a higher level and brokerage mechanisms to make connections
Laboratory	Experimentation around core ideas and creating in context a new system through recombination of proven elements from elsewhere
Prototyping	Development of a scale version of the system which allows for testing and configuration in context with users. Also provides a 'boundary object' which can demonstrate potential and engage key agents in further development and diffusion
Scaling and diffusion	Codification of core model into a 'standard' transferable package which can be replicated. Importantly this allows for further innovation and continuous improvement via channels which integrate emerging ideas into the 'standard operating model'

Table 1: A process model CDI

Finally widespread diffusion depends on the codification of the new system into a transferable model – a 'standard package'. This does not mean that further innovation will not take place; indeed it is characteristic of the examples given that continuous improvement is embedded in their design. But the basic model has become standardized and codified to the point that it can be handed on to others who have not had direct experience and sufficient detail of the 'standard operating model' available to enable them to set up and operate in a different context. This part of the process is assisted by the fact that users and players have been involved in co-creating and especially configuring the model.

8 Similar patterns of shared experimentation can be seen in the activities of online user communities.

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5. Concluding thoughts

The examples in this paper highlight the potential for social entrepreneurs working under 'crisis' conditions to develop radical innovations which meet urgent social needs. By exploring and experimenting in the zone 3/4 space in *Figure 1* they are essentially engaging in a reframing of the selection environment and co-evolving novel solutions in a different context. The emphasis on openness to a wide range of solution options and the need for high levels of user input to configure and adapt solutions to suit the context means that such activity is very much at the forefront of innovation management practice. There may be scope for further acceleration of the entrepreneurial activity in this space enabled by the 'new' tools for open collective innovation – examples can already be seen in areas like healthcare, social welfare and education (*Bessant/Moeslein* 2011; *Bessant/Moeslein et al.* 2012).

But it is important also to recognize the potential for disruptive innovation. Whilst the original context for the crisis may be very different to that obtaining in the mainstream world of zones 1 and 2 the possibility exists that models developed in the new selection environment of zones 3 and 4 may migrate. This is the basis of *Christensen's* theory of disruptive innovation and a number of commentators have drawn attention to the potential for 'innovation blowback' or reverse innovation (*Seely Brown/Hagel* 2005).

Entrepreneurs are involved in creative destruction – and the challenge to established players in the mainstream of healthcare of communications and other services may well lie in new models being developed under crisis conditions. Whilst such disruptive innovation may be seen as a threat in the commercial world it may represent a powerful positive opportunity for improving social welfare in the mainstream context. Being able to offer quality healthcare at an affordable cost is currently one of the biggest challenges facing industrialized economies and CDI solutions may have considerable relevance (*Crisp* 2010).

Adopting such solutions may prove difficult because of the difficulties involved in reframing. Many studies of the 'not invented here' effect in innovation highlight the considerable cognitive and institutional barriers to adoption of radical ideas which emerge 'from out of the box'. There is a version of an 'immune system' which operates to protect established organizations but which can occasionally be too limiting in its operation and act as a barrier to potentially valuable new ideas.

As we suggested earlier the key here is reframing; zone 4 involves exploratory search in open-ended fashion. *Freeman* and *Perez* in their discussion of long-waves in economic growth suggest that there is a process of paradigm change similar to that originally advanced by *Kuhn* to explain 'the structure of scientific revolutions' (*Kuhn* 1962; *Freeman/Perez* 1989). Their view is that innovation takes place within a dominant 'techno-economic paradigm' (TEP) and this provides a powerful contextual frame; however periodic shifts – triggered by social movements, technological development or regulatory shocks – create the conditions within which the TEP changes. They argue that TEPs are effectively lenses through which innovators see problems and solutions; changing the lenses brings a new set of problems and solutions into focus. This pattern explains why major shifts in TEP – for example the current wave associated with information and communications technology converging around the Internet – are first characterized by a substitution approach. Innovations in this phase are essentially variants on the theme of 'doing what we do, but better' – replacing existing products and processes with internet-enabled variants. But as the new TEP begins to dominate (a process which may take decades) so the nature of solu-

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tions shifts to 'doing something completely different' – the emergent properties of the new TEP as a system begin to be seen. The rise of social networking as a powerful force shaping social, commercial and increasingly political movement is a good example of this.

The examples presented in this paper suggest that there is significant radical innovation taking place under crisis conditions which contribute to the 'greater good'. The ability to scale these and make a wider contribution may depend on changing mindsets and adoption behaviour in established organizations and institutions as much as on entrepreneurs creating new solutions.

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