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- **Title**

**Patents as Enablers of Social Innovation: An Assessment through RRI Framework and
SDGs Lens**

- **Summary (164 words)**

Social innovation is a promising tool in bringing about the required transformation for greater good in tackling the grand challenges. This paper studies social innovation of enterprises from multiple perspectives: from the research and innovation perspective, from the legal lens i.e. the intellectual property, patents in particular for fostering social innovation. The methodology involves literature review to identify few gaps and the dimensions of Responsible Research and Innovation (RRI) framework. The comprehensive theoretical discourse on these themes is followed by secondary databased study as descriptive analysis of five select case studies from the Patents for Humanity program of United States Patents and Trademark Office (USPTO), where patents working towards the humanitarian goals and social impact are awarded. The cases are evaluated along the key RRI dimensions and for their alignment towards sustainable development goals (SDGs). Findings show a positive implementation of these two frameworks in these cases. This paper primarily contributes to the literature on use of RRI framework for evaluation of patents' social impact.

- **Keywords:** Patents, Responsible Research and Innovation, Social Innovation, Sustainable Development Goals

- **Track: Innovation**

Social innovation and innovation in social enterprises and other not-for-profit organisations

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Introduction

Innovation has transformed the world around us whether technological or social, but the latter type of innovation is still lacking adequate attention, due to its major challenge of uncertainty. It is imperative to manage innovation in a sustainable way and with an act of responsibility towards society, given the pace at which technologies are being adopted and used for betterment of human life but not without a rethinking on their adverse impact. The working of these innovations require they be measured or mapped for their social impact along certain parameters to bring insightful findings. Responsibility to society, the environment and economy sums up as the three pillars of sustainability further linking innovation to the UN sustainable development goals (SDGs) which are also important in mapping the innovations. Patents as classic proxy for innovations, with the rapid pace of socio-technological change and significant rise in global usage of the patent system over the past decades, there is a need for contemporary perspectives on their societal impact (van der waal, 2023). The paper's main objective is to examine patent-based innovation as enablers of social innovation and at the same time map these inventions/innovations along the RRI framework and the SDGs goals being met in doing so. It discusses social innovation from multiple perspectives: from the eyes of behavioural scientists, from the responsible research and innovation perspective and from the intellectual property perspective. Together, these are expected to provide a holistic view on the societal impact of innovation anticipated or realized through the selected cases of Patents from humanity. How social innovation where people are the prime drivers and targets and where the focus is on solutions to existing problems in the society, is discussed. In doing so, we touch upon the

Responsible Research and Innovation (RRI), 2013, framework and its relevance in terms of assessing the innovation process embedded in the intellectual property (patents) used for the societal benefit. Further, how these patent-based social innovations are aligned towards achieving the SDGs is also looked into to reflect on sustainability-oriented innovation. The cases are selected through judgmental sampling, based on the author's choice of awarded patents in different years.

Literature Review

The prime motive of literature review in this paper is to review the selected themes in this paper and identify the gaps in the research areas. The gaps are addressed through a multidimensional study of the selected cases.

RRI Framework through Multiple Lens

There is a plethora of literature on Responsible Research and Innovation (RRI), either on Responsible research (RR), Responsible innovation (RI) or consolidated RRI framework, still unanimous definition for the same is lacking. The literature review on RRI majorly focuses on a generic discussion on the evolution of RRI, and its current status. Literature search has been done using science direct, web of science, proquest, EBSCO and databases and google scholars, with the use of following keywords: responsible innovation, social innovation, measuring the impact of innovation on society, innovation and sustainability, sustainability-oriented innovation and patents in social innovation etc.

RRI framework has its origin in Stilgoe et al.'s (2013) work in the geoengineering sector of UK, in course of which the term “responsible innovation” was defined and its four integrated dimensions “anticipation, reflexivity, inclusion and responsiveness” were suggested by the authors. According to Chaturvedi et al., (2016), RRI is seen as a process/an outcome/an idea that espouses some values and identifiable criteria to measure whether an activity/process/product conforms to RRI. The meaning of RRI is dependent on what kind of responsibility is being taken up, and which in turn is contextual to the basis of innovation's contribution in meeting a

particular objective. Innovations can be assessed, using the four dimensions of RRI, anticipation, reflexivity, inclusion and responsiveness. These dimensions are elaborated in Exhibit 1a and Exhibit 1b.

Stahl et al., (2017) further compiled a series of views on RRI offered by different scholars. The concept of RRI is explained as a novel attempt to promote a novel governance method for Research & Innovation. It has been described as a “way of thinking more systematically about the public benefits of science and technology-based research” (Nuffield Council of Ethics,2013). Various definitions from key contributors to the discourse are in sync with this broad description. For example, the most widely employed definition by von Schomberg (2013) describes RRI as follows:

“transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)”

This is a broad definition and so are other definitions given by David & Las (2013); Rip (2013). Stilgoe’s framework was later adapted and adopted by the UK Engineering and Physical Sciences Research Council to form the AREA (anticipation, reflection, engagement and action) framework given by Owen (2014). European Commission (EC) has a highly influential contribution to the RRI discourse and this has a significant influence on research policy towards RRI, as it has adopted RRI as a cross-cutting activity that informs all aspects of its Horizon 2020 research framework program in years 2014 to 2020. For RRI, EC outlines a number of pillars that correspond to established research policy areas: civil society engagement, gender equality, science education, open access, ethics compliance and governance (European Commision, 2011,2012). According to Goujon et al.,(2014), Responsibility, Transparency, Interactivity, Ethical Acceptability, Sustainability, Social Desirability, and Embedding of Scientific and Technological Advances in Society have been identified as the key elements of RRI framework. Rip (2014) points out that RRI is a social innovation that is being articulated where its novelty lies in the roles and responsibilities of actors and stakeholders in research and innovation. Though RRI first came into existence in 2010, to understand its novelty and to tease out its practical relevance, it is necessary to understand the concept as a higher level or meta-responsibility (Stahl,2013) which needs to shape, maintain, develop, coordinate and align

existing and novel Research and Innovation-related processes, actors and responsibilities, with a view to ensuring desirable and acceptable research outcomes(Stahl et al.,2017).

“Responsible Innovation means taking care of the future through collective stewardship of science and innovation at present” (Stilgoe et al. 2013).This definition has a partial overlap (with the concern for future) with the definition given by Brundtland Commission “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” In this context, it seems a relevant reason to study the two processes in conjunction for better innovation management. Though the link between SDGs and RI has not been explored much, Lehoux and William-Jones (2018) and Lehoux et al., (2019) have tried to explore this by working on the weak linkages in responsible innovation in health (RIH). Using the technique of web-based horizon scanning, they identified 105 health innovations with responsibility features and explained with the help of empirical examples, how RIH addresses the SDGs. According to Genus and Iskandarova (2017) expresses his doubt in the building of RRI as a truly responsive, inclusive and reflexive approach to governing innovation due to the fact that this being a developing area in research and practice in which there are dominant perspectives, practices and actors, which combine to inhibit the process of an actual RRI.

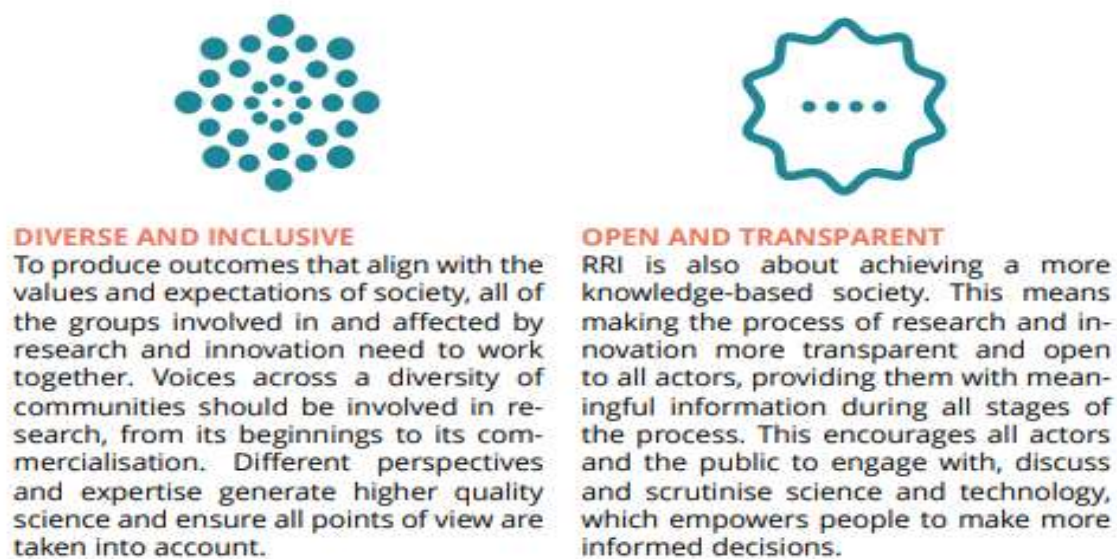


Exhibit 1a: Dimensions of RRI framework (Stilgoe et al.,2013)



Exhibit 1b: Dimensions of RRI framework (Stilgoe et al., 2013)

Management of Innovation and Sustainability-Oriented Innovation

Tracing the concept of innovation from Schumpeterian model of “creative destruction” (1942) to current times, the construct “innovation” has added new dimensions and meaning to its existence, making it more difficult to manage innovation in view of the evolving technologies and a myriad ways of doing and creating things. Whilst in the past innovation management has been primarily focused on the economic (i.e. market) success of products and services, in the context of sustainability, innovation also needs to take social and environmental spheres into account which makes way for sustainability-oriented innovation (SOI). SOI means even higher risks with the additional environmental and social dimensions (Dyllick & Hockerts 2002; Fichter & Paech 2004; Paech 2007; Hansen et al., 2009) but in turn, this reemphasizes the importance of RRI. SOI is linked to ‘directional risks’, due to the uncertain nature of the direction of (environmental and social) sustainability impacts of innovations, particularly in the long term. This uncertainty becomes a major challenge to innovation management so SOI assumes more significance in context to RRI. To illustrate, there are cases of biofuels being beneficial as well as being harmful to the biodiversity. This actually undermined its initial positive impact, raising questions on biofuels. In a recent report, a host of behavioural scientists (Van de van et al. 2017) have commented on the miracles of emerging technologies like AI and machine learning, which on one hand as automating production control systems yield significant benefits for society, on

the other hand, it creates the imperatives on governments to provide safety nets for labor in anticipation of their replacement by automation. This ultimately affects the future of work. Emerging technologies are increasingly promoted on grounds of tackling the grand sustainability challenges though disparate evaluation and governance steps impede widespread operationalization (Matthews et al.,2019).

From the legal context, in an era of emerging technologies, intellectual property rights and regulatory regimes may constrain diffusion and usage of technology, well proven in the case of India, where RRI has been explored in case of agricultural technological choices with suggestion of a new approach to policy formulation with state's intervention (Chaturvedi et al., 2016). The Indian scholarship on RRI aims to align the processes and outcomes of innovation with societal values by involving a broad range of stakeholders from a very early stage (Silva,2018; Chaturvedi et al.,2016). Linking of RRI with the understanding of access to and availability of innovations can lead to a coherent policy framework that promotes both access and socially responsible innovation. This also makes addressing controversies easier in development and use of innovations. Socioeconomic assessment is a comprehensive process to be undertaken at different stages (Chaturvedi *et al.* 2016). It has been put into practice in many countries and has linkages with sustainable development. Since, socio-economic assessment goes beyond cost-benefit analysis and can provide a comprehensive assessment of an innovation and its impacts on various stakeholders, it has a major benefit. RRI has been primarily put into practice in Europe, its relevance elsewhere is not yet visible. Hence, according to Chaturvedi et al., (2016), RRI is seen as a process/an outcome/an idea that espouses some values and identifiable criteria to measure whether an activity/process/product conforms to RRI.

Another study, which seeks use of the RRI framework is by Silva et al., (2018) in the health sector of India. The author raises concern over the growing number of new technologies being introduced in health systems (e.g. wearable devices, robotics, genomics, artificial intelligence, 3D printing, mobile applications, etc.). These raise complex policy challenges “for all health stakeholders, including policy makers, regulatory authorities, payers, physicians and patients” (OECD,2017). The current ways in which new health technologies are being financed, developed and brought to market render health systems that are increasingly getting inequitable and unsustainable. The author, in response to this concern, has tried to define the dimensions that

specifically characterize responsible innovation in health (RIH) as an integrative RIH framework. This framework uses insights from RRI literature, the international literature on health systems as well as specific bodies of knowledge that shed light on key dimensions of health innovations.

Patents and Social Innovation

Patents as classic proxy for innovation (Griliches,1999), represent inventions over which the inventors have monopolistic right but with a trade-off to disclose their inventions before they get the rights. There are four main economic impacts of patents: the creation of incentives to innovate, the diffusion of knowledge through information disclosure, facilitating technology transfers through licensing, and the organization of cumulative R&D (Leveque et al.,2007). Of these, the first three are the prime role of intellectual property while the fourth one is the most complex and debatable area. Available evidence suggests that patents globally have a positive effect on innovation in Computers and Electronics (Lévêque and Menere, 2007) though in sectors like pharmaceutical and more so in biotechnology, they might act as barriers to innovation.

Primarily, the motive for patenting has been profit though their use for social benefit is very much enshrined in the Trade- Related Aspects of Intellectual Property rights (TRIPS),1995 under the World Trade Organization (WTO). A balance between profit and societal benefit is yet to be achieved fully. Moreover, the patent system is a socially shaped enterprise where private and public concerns intersect. Despite the notion of the social utility of inventions as a patenting condition, and evidence of disconnection between societal needs and the goals of private actors, less attention has been paid to other interpretations of patent value (Ribeiro and Shapira,2020). Since the 1958 Machlup review, understanding the evaluation of patent system and their effect has increased with some of the notable reviews: its costs and benefits analysis by Kitch (1977), Mazzoleni and Nelson (1998), Hall and Harhoff (2012) and Hall (2022). Yet, van der Waal et al., (2023) report that despite a vast body of research, there appears to be no consensus on its societal value, so far. The authors opine, given the rapid pace of socio-technological change and significant rise in global usage of the patent system over the past decades, there is a need for

contemporary perspectives on patents' societal impact. This study tries to fill this gap by taking the select case of Patents for Humanity. For more than 200 years, patents have supported technological and economic progress in industrialized nations. As the world strives to bring the benefits of modern technology to the rest of humanity, patents continue to play an essential role in creating lasting solutions not only in terms of profit for the business, but lasting solutions for the underprivileged in the society.

In case of the patents meant to be used for social good, there are questions on why patents are required on such innovation, when innovators especially in developed economies where they do not plan to use them. It has been realized that patents nevertheless have multiple roles for the innovators, in terms of securing funding, forming partnerships and attracting talent, particularly for small organizations, dual-licensing business models for technologies that have uses in both the developed and developing world. The dual licensing follows a differential cost pricing (affordable) while licensing the inventions/technologies in developing and developed countries. For example, 2015 winner of the Patents for Humanity award by USPTO, a social enterprise, GRIT licensed its all-terrain wheelchair technology to low-cost manufacturers for use in developing regions while also selling a version for recreational use on off-road trails in the United States. These licensing sales revenue from developed countries, can also be used in funding activities in developing countries.

Social innovation refers to innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly diffused through organizations whose primary purposes are social (Mulgan,2006). Despite a series of social innovation activities between 1960s to 1990s, it is still understudied for lack of initiatives to accelerate this process and the process being shrouded by uncertainty. Mulgan (2006) emphasizes, today most discussion of social innovation tends to adopt one of two main lenses for understanding how change happens. Through the first lens, "the how is answered" i.e. social change is portrayed as having been driven by a very small number of heroic, energetic, and impatient individuals, while through the second lens, it is about "who drives social innovation", individuals or broader movements??. Both of these point to the cultural basis of social innovation-the combination of exclusion, resentment, passion, and commitment that make social change possible. However, with times,

social innovation is now not restricted to the organizations with primary purpose being social, rather, the concept of “doing business for good” has got embedded in all the organizations’ mission in terms of corporate social responsibility. These points are well illustrated by the several cases of Patents for Humanity discussed further in this paper.

Moreover, Patents for Humanity justify the Cuntz et al.’s (2020) proposition that the main criterion for identifying a social innovation concerns the way the benefits generated by an innovation are distributed between the (private or public) innovator and society. As per this view, in case of Patents for Humanity, patent rights are retained by their owners, while at the same time, the benefits are made available for societal good/welfare.

Overall, the literature review on the studied themes, suggests an unanimous definition of RRI is not possible till now, due to its context-specific nature and objective. However, for our study we have used the RRI definition and its dimensions as suggested by Stilgoe et al.,(2013).Both SOI and SDGs though with partial overlap in their meaning, do reaffirm the need of taking RRI in context to study social innovation, which is heavily shrouded by uncertainty. The global usage of the patent system over the past decades has been on the rise, but the contemporary perspectives on patents’ societal impact, is yet to be fully explored and understood.

The literature review on the given themes identifies some important research gaps: the use of RRI framework in evaluating innovative projects and these further raise important research questions in the form which RRI parameters to employ in the evaluation of such projects. The role of patent-based innovations in fostering social innovation to serve a public health/welfare motive rather than merely the profit motive, dearth of adequate studies exist on this topic and a lack of consensus on this have been identified as major gaps in this area.

Accordingly, this paper has one overarching research objective with two sub-objectives:

- To study patent-enabled social innovations,
 - To map the select cases of Patents for Humanity along RRI framework.
 - To map the SDGs in these social innovations (as reflected by patented inventions).

Responsible Innovation in Action: Case studies on Social Innovation

Patents for Humanity

Very little work has been conducted on Research and Innovation (RI) in a development setting. There may be even more need for RI frameworks in innovation research in Global South countries given the challenges of working in a development setting (Chambers,2008). However, social innovation research is being discussed in general without any geographical boundary. Adopting Biddle's (2017) suggestion that a technology might be considered a responsible innovation if it addresses a societal challenge that is locally defined, the technological research is conducted in local contexts, and the technology is accessible (also an attribute of frugal innovation) to those who need it most, this paper studies Patents for Humanity, a pilot initiative by the United States Patent and Trademark Organization (USPTO). A first-of-its-kind prize competition, it was started to reward innovators for the use of patented technologies to address humanitarian needs. This study analyses the case studies on some of the select awardees of this program between 2012-2022. For game changing innovations offering solutions to development challenges and combining it synergistically with the business interests, strong patent rights are a must for maintaining commercial markets for the innovative products of the innovators. Such innovations are awarded as Patents for Humanity by USPTO program that recognizes innovators who overcome these challenges to bring life-changing technologies to those in need. Its purpose is twofold. While on one hand, it highlights through success stories, how the unrepresented masses or underserved communities can be reached with solution. Second, by providing value to award winners, this program balances the diminished commercial incentives in these regions, instead further motivation for carrying out innovative projects in the desired areas, are created. This value includes public recognition of winners' work and a voucher for accelerating certain matters before the USPTO. Revisiting the economics concept of incentivization for innovation, the inventors are doubly blessed as their innovations benefit the society by aligning the goals to the SDGs, on one hand and ensuring commercial gain on the other hand. From inception (2012) till date (2022) and excluding year 2023 as the awards are yet to be announced, 45 awards have been given in different categories ranging from medicine, nutrition, household energy, living standards and sanitation. The awardees are entities from large multinational corporations to small

companies and startups as well as universities and non-profit organizations. The work of the recipients proves, it is all about focus and commitment, even a small group of people with can impact lives around the globe. The prime criteria of selecting the awardees are the use of game changing technologies for humanitarian needs (USPTO, 2023). The awards showcase how visionary patentees are leading with innovative ways to provide affordable, scalable, and sustainable solutions for the less fortunate. In other words, how patentees through their technological innovations are contributing towards social innovation.

Research Methodology

Research Design

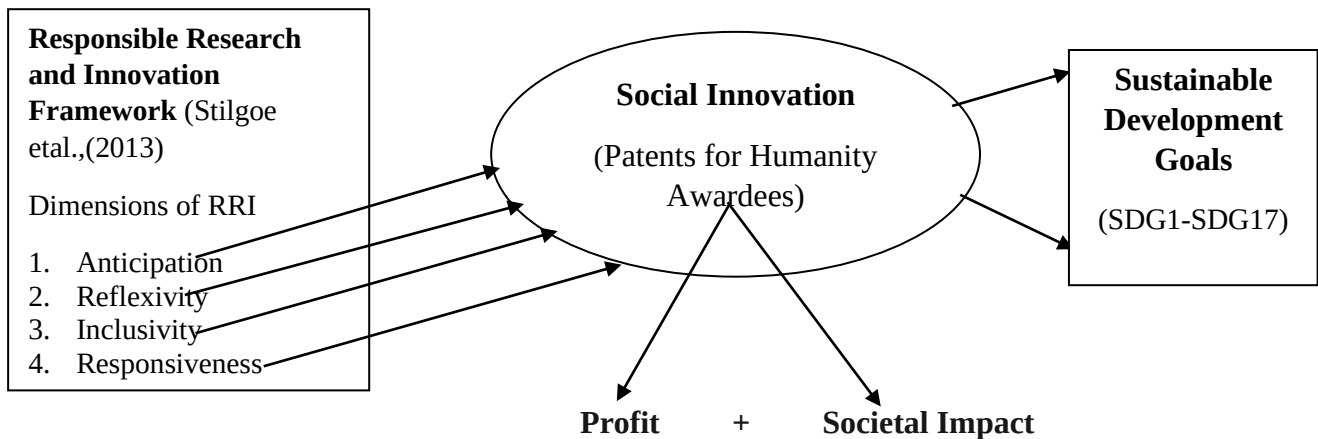


Exhibit 2: Patents for humanity as social innovation assessed through RRI framework and SDGs

Based on the above discussion, the research design is outlined in the Exhibit 2 linking the concepts to be studied. We use the concept of RRI propounded by Chaturvedi et al., (2016) who state that RRI is seen as a process/an outcome/an idea that espouses some values and identifiable criteria to measure whether an activity/process/product conforms to RRI. Accordingly, the methodology is based on analysis of innovation in Patents for Humanity: i) measuring patent-enabled innovation along the dimensions of RRI framework, ii) assessment of patents-based innovations as social innovations iii) alignment of the patent-based innovation with SDGs. Select cases on Patent for Humanity are analyzed along these lines. Case studies have been used to describe, explore and explain (Yin, 1989). For this study, a descriptive case studies approach has been adopted, which centers around such questions as "what," "who," and "where

(Cunningham, 1997). Case study has also been described by Twyle and Cross (2017) as an intensive, systematic investigation of a single individual, group, community or some other unit in which the researcher examines in-depth data relating to several variables. As per this definition, the organizations who have been given Patent for humanity award are examined as units, through their text data related with the common variables for all units- application of the parameters of RRI framework, their patents' role in social innovation, alignment to SDGs etc.

A multiple case study approach is adopted in this paper and all the common variables/themes are studied across all the cases. Most of the information is collected from the USPTO and company's websites, literature and reports, newsclips and videos.

Data

The data used in this study is text data from secondary resources on the awarded organizations and their patents containing technologies serving humanitarian goals or in other words, meeting the global sustainable development goals. There is a lot of dependence on the secondary database in this paper while studying patents as enablers of social innovation process through Patents for Humanity award system of USTPO.

Sampling

For studying the cases on social innovation in social enterprises and the non-profit organizations, a sample of 5 cases i.e. 5 units which received Patents for Humanity award between 2012 to 2022 was selected. The choice was made based on judgemental/purposive sampling by applying a set of criteria as per the need of this study. Using an indirect reference to the assumption that frugal innovations are most likely responsible (in terms of societal needs) and inclusive innovation, employing one to three of the most commonly accepted attributes of frugal innovation as quoted in literature by Radjou & Prabhu (2015); Weyrauch & Herstatt (2017), the entities were initially screened. A majority of the inventions/innovations were described as rapid/fast/quick/ease of use/easy to assemble/easy to transport; simple/ultralight weight/easy to maintain; inexpensive/low-cost/at-cost basis/portable. Of all these attributes, low cost was the most commonly occurring term which is very important from the perspective of innovations being used for the society and perhaps their likely benefit. Then, innovations serving a broader

and more basic need of humanity were selected. This filtering led to a final selection of 5 out of 21 awarded cases for a detailed analysis of their alignment with RRI framework, with SDGs, in other words, their nature being sustainability-oriented innovation.

3.Case Studies on Social Innovation

The 5 selected cases have been discussed along the common themes of anticipation/identification of problem/an unmet need, solutions which are innovative, sustainable, creating a large social impact, involving multi-stakeholders/actors and adopting an inclusive approach. These themes run across all the case studies, as pointers of social innovation which align along the parameters of RRI and target the SDGs. The assessment of social innovation in each of these cases of patents, is presented in Table 1 and Table 2. All the products and processes/methods mentioned in the given cases have been covered by patents which act as enablers of social innovation.

a. Nokero (2013)

Nokero, a novel solar light stands for "No Kerosene". It is a live example of providing solar energy in no-grid areas by a local enterprise. They replace kerosene lamps and candles with solar lights which are safe and sustainable since it provides economic, environmental and social benefit. It soaks in the sun, then releases the energy at night. Nokero lights charge by day as it operates on solar panel and bring light by night. Recharging Nokero is free. It consumes 1/200th the energy of fuel lights. Providing a solution to energy poverty which is real, costly and deadly, Nokero, provides the clean energy from sun which makes the rural communities safe, happy, healthy and productive. A new product and patent in just 4 days, made the inventor realize that his solar light bulb could potentially make a huge impact on the 1.4 billion people around the world who don't have access to an electrical grid. By inventing, engineering, and producing the world's most efficient solar lights, they affordably lifted 1.2 billion people out of the dark, with the global mission of removing darkness. SunPower solar technology is designed and manufactured by Maxeon Solar Technologies, a global leader in solar innovation. The company lays major emphasis on sustainability and reiteration of users' need before embarking on further R&D. Nokero uses Maxeon solar panels which are lead free and made with recyclable materials

in resource efficient facilities. Maxeon panels have multiple third-party certifications for sustainable manufacturing. And backed by an incredible 40-year warranty, they won't need replacing for decades, greatly reducing waste.

Nokero is clean, efficient, and long-lasting. The solar lights eliminate the harmful exposure to kerosene particulates for an entire family, reducing energy costs for families who spend up to 25% of their monthly income on kerosene and candles. Adding more to this sustainable innovation, Nokero's smallest solar lights are one-third the size of the industry average, making them fit easily into a pocket and efficient to transport in large quantities to hard-to-reach markets. For organizations working to improve the lives of people worldwide without reliable access to electricity, they're indispensable.

Insights: The patented invention in this case served unmet and a grand challenge to humanity i.e. energy poverty, is sustainable, catering to the needs of a large population, is available in inaccessible areas, is cost effective. Overall, this innovation is benefiting the society at large by providing sustainable solutions to energy poverty. It exemplifies responsible research and innovation theme.

b.GRIT (2013)

The Global Research Innovation & Technology (GRIT) Freedom Chair was created by engineering graduates from the Massachusetts Institute of Technology (MIT) in the USA to increase mobility for people with disabilities, especially on rough terrain. This social enterprise-start-up, designed its chair which is made from standard bicycle and enables local repairs with available materials. An estimated 65 million people in the developing world require wheelchairs. This chair is an example of a solution to a very common problem of normal wheelchairs restricted movement in rough and uneven terrain commonly found in developing regions. GRIT offered this solution as three-wheel Leveraged Freedom Chair which uses a push-lever drive train to help people move over uneven terrain such as broken pavements, dirt roads, fields, hills, rocky terrain and more. The students transferred their patents to MIT for further development of the technology and launch the product to the market. The chair has been distributed in

partnership with the World Bank, the Red Cross and others in Brazil, Easter Island (Chile), Guatemala, Guinea, Haiti, India, Kenya, Nepal and the United Republic of Tanzania.

Insights: In this case also, the patented invention has brought solution by meeting the needs of the disabled population to use the wheelchair in uncharted terrain, an uphill task. So, with a focus on an unmet need, it too qualifies as a social innovation and aligns well with the parameters of RRI framework.

c. Medtronic (2018) for Health Sector

Medtronic, is medical technology services and solution company spread over 150 countries across the world to be the world's largest medical technology, services and solutions companies. It created a portable, low-water kidney dialysis machine for potential use in a wide variety of care settings, including those that lack the infrastructure required for traditional dialysis. Kidney disease is a chronic condition that affects more than 700 million people worldwide, and millions die each year from lack of treatment. The solution provided was in response to the widespread impact caused by this disease. In developing countries, often suitable treatment options are not available outside of major cities. The device in development weighs about 50 pounds and is the size of a large suitcase, making it roughly 10 times smaller and lighter than conventional dialysis machines. With only approximately 20 liters of usage of potable water per treatment, it reduces the water use to 75 percent less than current systems. The machine has easy to use interface, is designed to be affordable and expands patient access in more parts of the world. In China, based on its innovative device pathway, it was granted priority status in 2017 and the company also intends to seek regulatory approval in other regions of the world. The emphasis is on patient-focused innovation.

Insights: This patent-based invention has provided a sustainable solution to a widespread impact caused by a very common ailment-kidney disease. It expands the use of much needed kidney dialysis machine in terms of its affordability through cost and size and easy availability in all areas.

d. Sanivation LLC (2018) for Health, Sanitation and Energy

Sanivation LLC, a social enterprise based in Kenya, has designed a waste processing plant that transforms human waste into solar thermal energy to produce sanitary briquettes which are used in place of wood and charcoal for heating and cooking. There are already four plants serving 10,000 people in Kenya. This is an example of innovation based on recycle and reuse model, which turning the waste treatment plant into a profit generator, not a cost center. This fuel is a solution to up to 90% of human waste which is disposed and untreated in developing countries, contaminating the ecosystem raising health concerns. Globally,diarrheal disease due to inadequate sanitation cause 829,000 deaths per year, It is the second leading cause of death in children under the age of 5. Malnutrition resulting from diarrheal disease exacerbates the physical and mental health of the children in terms of impaired growth. The global economy lost over \$223 billion in 2015 due to this problem. The company has setup three plants in Kenya which provide 2500 people a month with sanitation and energy services that are more cost-effective than existing alternatives. Their briquettes burn longer than charcoal and produce one-third the carbon monoxide and particulate emissions, saving 88 trees per ton sold and reducing pollution to a great extent. Sanivation's work has been supported by the US Centers for Disease Control, the UN Refugee Agency, the Gates Foundation, and the Kenyan government. Sanivation is building additional plants with the goal of serving 1 million people by 2022.

Insights: The given patented invention relates to the circular economy model of recycle and reuse to utilize the waste to provide better energy alternatives (thermal energy) which is pollution free and long lasting. While on one side, it is taking care of pollution, elimination of disease in children, it is providing relief in terms of energy to the society.

e. Because International (2018) for Health Sector

Because International is a non-profit dedicated to providing shoes for children in poverty and they were recognized for distributing 180,000 pairs of resizable shoes in over 95 countries over the three years, with local manufacturing taking place in Ethiopia and plans for Haiti and Kenya.

A leisurely walk in Kenya, along with a small girl with small shoes, made Kenton Lee think about innovation-a shoe that could adjust and expand i.e. a shoe that grows. In 2014, his dream took shape as “The Shoe That Grows”. It is an innovative shoe designed specifically for kids challenged by poverty. This shoe was made of high quality Velcro and upper materials. And its innovative hook- and- loop toe piece allows for the greatest amount of adjustments by expanding and contracting the sole of the shoe, which is a single, molded piece for increased durability. This design has undergone rigorous testing both in the factory and in the field to ensure that the shoe lasts. The shoes can adjust and expand 5 sizes and last for years.

Soil-transmitted illnesses affect over 1.5 billion people in the world, many of whom are children who simply don’t have a pair of shoes. These illnesses can lead to nutritional and physical impairment, inability to attend school, and physical suffering. However, shoes donated from industrialized countries do not always work well since children outgrow donated shoes, and they often fall apart. To remedy this, Because International founder Kenton Lee designed an adjustable sandal-like shoe that can be expanded as a child grows. The shoes can be made with local materials and last for years. They recently started producing shoes in Ethiopia, providing jobs for impoverished communities, and plan to open other facilities in Haiti and Kenya soon.

Insights: This patented invention has provided solution for poor children’s need for shoes to protect them from soil-borne diseases. It has catered to a niche area where a part of the community has been provided a sustainable solution in the form of affordable shoes that grow with age.

Assessment of Cases through RRI framework and SDGs Lens

Among the most accepted parameters of RRI framework, while anticipation means debating and deliberating on key points of research and innovation in a particular technology, inclusion refers to taking care of users’ needs right from the stage of R&D and the impacts and interests of different stakeholders. Reflexivity as the term implies would mean closer inspection of values and objectives in the research and seeking inputs from different disciplines as that of the research. This calls for engaging with insights from other discipline’s and all the stakeholders’ perspectives. Responsiveness refers to more transparency, accountability and deliberative policy-making; being open for possible changing circumstances- and adaptive change-actually act

according to changing circumstances (Kupper et al., 2015); an iterative, inclusive and open process of adaptive learning with dynamic capability (Owen,2013). When these four dimensions are applied to all these 5 cases of patent-based social innovation, it is observed that except for the “responsiveness” dimension, where there is no clarity, all the other three dimensions have been a basis of their venturing into social innovation process and designing solutions (Table1). This justifies these innovations’ alignment to RRI framework. In the management sciences, the use of RRI framework for capabilities development has also been studied through these cases. Ogoh et al., (2023) refer to the notion of capabilities studied over years as the ability to achieve certain goals, which these cases exemplify.

Each of the cases is targeted towards a set of SDGs, which are identified in Table 2. Health related (SDG3) and Industry and infrastructure (SDG9) have prominently figured in the endeavors of studied cases.

Table1: Assessment of Cases of Social Innovations for alignment along RRI Dimensions

a.	Dimensions of RRI (Stilgoe et al.,)	Nokero	GRIT	Sanivation LLC	Medtronic	Because International
1	Anticipation	√	√	√	√	√
2	Reflexivity	√	√	√	√	√
3	Inclusion	√	√	√	√	√
4	Responsiveness	-	--	-	-	-

Table 2: SDGs Alignment in these Cases of Social Innovation

The 17 UN Sustainable Development Goals		
	1. No poverty 2. Zero hunger 3. Good health & well-being 4. Quality education 5. Gender equality 6. Clean water & sanitation	9. Industry growth & infrastructure 10. Sustainable cities & communities 11. Responsible consumption & production 12. Climate action 13. Life below water 14. Life on land
	The Entities	SDGs alignment
1.	Nokero Solar	SDGs 3,7
2.	GRID	SDGs 3,9,15
3.	Sanivation LLC	SDG 6
4.	Medtronic	SDGs 3,9,12
5.	Because International	SDGs 3,11,9,12

After assessing all of the 5 cases, it has been found all the products and methods designed by their respective companies/individuals, conform to only three dimensions anticipation, inclusiveness and reflexivity except responsiveness of the RRI framework, identified by Stilgoe et al., (2013). All the given solutions were a response to some of the very common grand challenges/unmet needs and have created a large impact on the society with their innovative and sustainable solutions. Since these were responses to the grand challenges, there was readiness for the acceptance of these offered solutions.

Conclusion

Contribution of this Research

The theoretical discourse on studying social innovation through the RRI framework and SDGs lens is based on the study of IP-mediated (patent-based) social innovation. The study wholly

based on secondary data helped in reflecting upon these concepts and analyzing the real life social impact of IP (patents), an aspect less studied vis- a-vis the role of patents as profiteering tools. To summarize, the cases analyzed confirm to the shared principles of RRI in terms of (1) address of societal needs and challenges (2) engagement of a range of stakeholders for improving decision making (3) anticipate potential problems and assess available alternatives as solutions.

This paper contributes to the literature on RRI evaluation by focusing specifically on the key dimensions of RRI and how the innovators bringing about social innovation have adopted this framework along with the SDGs. It also shed light on the capabilities development of organizations in context to RRI.

Implications of the Findings

The major takeaway from this study is an understanding of the RRI framework, its abstract, contextual and evolving status. In view of this, managers or practitioners learn to implement it in an objective and contextual way. How to use the patents in balancing the social benefit and economic gain from innovation is another major takeaway.

Limitations and Future Research

This study has some limitations which can be addressed in future research. Firstly, instead of a small sample size, a larger sample size can be studied for a more generalized insights on how patent-mediated innovations create social impact. Moreover, the role of patents in social innovation is quite understudied, so it can be explored further. Secondly, social innovations can be studied from different lens i.e. how the process happens and who drives social innovation, themes which still need adequate exploration.

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