Chapter 5

Intellectual property issues in Open Source Drug Development – An empirical study on CSIR's OSDD Project

Before the success of open source, it would have been very difficult to convince anybody that social sharing and exchange will one day become the modality of economic production. But after its success in software industry, many tried to expand the concept and argued for its implementability in newer areas. Open source drug discovery is one such experiment to test the suitability of adopting open source production model in pharmaceutical research. The concept of open innovation, indeed offers enormous possibilities in organizing productive forces outside the constraints of market and manage intellectual property in a distinct manner which was traditionally unfamiliar. Now this is being increasingly accepted as a viable solution for the R&D crisis due to scarcity of innovations. Open Source Malaria, CSIR's OSDD, Medicines for Malaria Venture, Lilly's OIDD are all examples of attempts to implement open innovation in drug discovery research.

3 See for details on Open Source Malaria at <http://opensourcemalaria.org/> (accessed 21 September 2016)
4 OSDD is piloted by Council for Scientific and Industrial Research, Government of India. See for details <http://www.osdd.net/> (accessed 21 September 2016)
5 Details on Medicines for Malaria Venture is available at <http://www.mmv.org/research-development/open-source-research> (accessed 21 September 2016)
6 OIDD is promoted by Eli Lilly and Company. See <https://openinnovation.lilly.com/dd/> (accessed 21 September 2016)
People often perceives open source as a community where volunteers beeline to contribute and participate in the development of a product which is made available to public under certain peculiar license terms. But unlike other sectors, adoption of open source production model in pharmaceutics generates many complex issues in terms of organization, implementation of collaborative production, delivery and intellectual property management. There may also arise many challenges in terms of managing the intellectual assets created through collaborative research. By theory, open source is a distinct model of social organization. But it is still puzzling as to how it is possible to organize social labor in a production model which lacks any monetary incentives. This also challenges the theory of link between labor and wages and its relation to productivity. It would be really interesting to find out what would motivate people to contribute for pharmaceutical research. All these issues need to be analyzed through an empirical study on a working model of open source drug discovery. CSIR's OSDD is taken for the study mainly because the project is based in India and thus conducting a survey was easier in terms of logistical issues. This empirical analysis offers the possibility of resolving certain of such puzzles and examines the implementability of open source model in drug discovery.

5.1 Intellectual Property Issues in Open Source Models for Drug Discovery

There exists a dominant thought that the role of intellectual property law in an innovation environment is to provide incentives to fuel creativity. The whole idea behind theorizing the incentive factor is that, people won’t create or invent things without incentives. Utilitarian thinkers have asserted that IPR’s provide ‘the prospect of reward’, which encourages creative process by providing incentives to create, invest in creation and further develop creative ideas. They even argue that

---

7 Some economists have proposed the theory that labor productivity is directly linked to economic incentives. See for further reading Samuel Bowles, ‘The production process in a competitive economy: Walrasian, neo-Hobbesian, and Marxian models’ (1985) 75(1) The American economic review 16.
without intellectual property rights, creative process would be weakened\(^8\). In a context where the products of creative labor are easily copyable, law establishes the right of the creator over the creation and limits the ability of others to use or enjoy the creation. For the supporters of incentive theory, neither the inventions nor their exploitation will take place unless the inventors and capitalists are promised with profits that will reward the efforts they have put in. In fact, the whole philosophical foundation of intellectual property rights is based on the reliance on this notion of incentives, that the naturalists, utilitarians, lockeans, moral right thinkers all alike tries to theorize the role of right based incentives in creativity and differs in opinion only with regard to the balance that must be maintained with societal interests.

Two common criticisms against this role of intellectual property is that it rewards innovation beyond what is necessary to spur innovation and that it hinders access thereby preventing continued creativity\(^9\). These issues have been a subject of discussions and debates for a long time. There also exists considerable literature that exposes the negative effects of intellectual property rights and its impact on creativity\(^10\). Such works argues to bring in a more balanced approach towards harmonizing the creator’s property rights with the social necessities of human life. But contrary to all this, now there exist a new direction of thinking that tries to establish that artificial inducement to artistic and technological creativity is not necessary at all\(^11\). If the logic behind patents and copyright is incentive theory, then open source evidences a context where intellectual property based incentives has no relevance at all and the role of law as a tool that can incentivize innovations is completely negated. When it comes to the psychology of creators, there exist ample

---

10 See Michele Boldrin and David K. Levine, Against Intellectual Monopoly (Cambridge University Press 2008); Stephan N Kinsella, Against intellectual property (Ludwig von Mises Institute 2008)
empirical evidence in open source that suggests that extrinsic rewards have the opposite of intended effect and can actually defeat inherent motivation. This challenges the foundation of intellectual property ideals and lead us to a bigger puzzle that, what would be the role of intellectual property in this new innovation environment. In a situation where monetary incentives have no relevance, there may exist certain intrinsic motivational factors that incite the creators to engage in creative endeavors. This needs to be identified to critically look at the incentive theories and attempt a rework in collaborative drug discovery models.

The significance of open source production model is in crowd-sourcing of research and its validation through a distributed peer-review process. When such a development model is implemented into a drug discovery framework, there may arise several challenges as to attracting qualified volunteers, developing a proper attribution system, making available the requisite research infrastructure, implementation of a governance system and the management of intellectual assets developed through collaborative research. Creator’s fascination towards open source culture is also associated with their aversion towards excessive control on creativity exercised by managers in capitalist model of production. The open source model relieves the creator from this excessive control and makes him part of the distributed peer-review process there by empowering him to make crucial decisions on the project’s output. But open source projects do have a governance system which indirectly monitors the creative process and sets the direction in which creativity shall flow. The success of open source projects in attracting contributors is often dependent on the visibility of this governance system to contributors and the magnitude of control exercised. Thus the real success of an open source model of drug discovery is also dependent on the existence of an efficient governance system that has the ability to intervene at the right time and direct creativity to desired results without exercising any direct and visible control on the creative process.
Drug Discovery process involves several steps like target fixing, diagnosis, base material identification, clinical trials, product approval and finally successful marketing which could be materialized only through a systematic approach. These are lengthy and expensive processes which would cost around several million dollars. All these steps must be carried out in compliance with stringent laboratory standards which require meticulous control and recording of every aspect of the process. With sufficient per-clinical data evidencing safety being obtained, the developer can move forward to clinical trials in human beings. But this is also subject to regulatory approval by appropriate statutory body under stringent conditions. Clinical trial itself is a step by step process spread across three to four phases which will provide data regarding safety, side effects, efficacy, dosing, toxicity, potential reactions etc. of the drug. It will be a difficult process to take the final product through different stages of market approval while being in an 'open platform'. Moreover, IP considerations arise in almost all of these stages. It is important as to how the open source framework will adapt to protect collaborative research in these stages. When drug discovery is done in a collective innovation scheme, complex IP issues may emerge at these different stages. So the corresponding IPR protection in each stage and its implications may also create hurdles in open source licensing. This makes the licensing choice a difficult task for open source drug development projects. These complexities also affect the formalization of open source drug development as a workable production model. Conducting a study on a live example of open source drug discovery would help in better understanding the complexities involved. An in-depth analysis of a working model of open source drug discovery will also offer the possibility of better understanding the potentials of open source production models. The empirical study


on CSIR’s OSDD project is framed in such way to examine the working of an open collaborative model of drug discovery and attempt to find answers to at least some of these issues.

5.2 CSIR’s Open Source Drug Discovery

OSDD is an initiative of Government of India's Council of Scientific and Industrial Research\textsuperscript{14}. It is aimed at implementing open source development model in pharmaceutical research. It operates open source platforms where the innovators can collaborate and collectively contribute to the solving of complex problems associated with discovery of novel therapies for neglected diseases. Even though it is aimed at pharmaceutical research for neglected diseases in general, the immediate focus is on TB and Malaria\textsuperscript{15}. OSDD’s participants vary from scientists, doctors, technocrats, students and people from many other fields with diverse expertise. The factor that binds them together as a community is the philosophy of doing drug discovery research in open source mode. OSDD has around 8000 registered participants from more than 130 countries. OSDD’s portal provides an interface for the participants to collaborate and contribute for research. It will act as a platform for both computational and experimental technologies associated with drug discovery. Members joining the project can utilize this shared workspace and also the data available there. In effect this will lead to formation of a large network of contributors who are interested in collaborating and contribute for drug discovery. The entire mission is based on the firm faith that free sharing of knowledge will create a better environment for creative collaboration which will eventually lead to accessible health- care. OSDD plans to spread its model to every stage of drug discovery.

\textsuperscript{14} CSIR is the premier industrial R&D organization in India. Details available at \texttt{<http://rdpp.csit.res.in>} (accessed 25 September 2016)

\textsuperscript{15} OSDD is mainly focusing on diseases prevalent in third world countries. They are often called as neglected diseases because big pharmaceutical companies shows little interest in finding cures for them. This is mainly because the affected population does not have the capacity to pay and thus the market is not profitable. See for details on OSDD \texttt{<http://www.osdd.net/about-us>} (accessed 25 September 2016)
discovery research from drug target identification to lead optimization. To deliver drugs to market OSDD intends to rely on generic industry business model. The drugs developed through OSDD will be made available like generic drugs without IP encumbrances so that generic industry can manufacture and sell it through their channels anywhere in the world.

A significant achievement that OSDD made so far is the successful creation of certain basic computational resources required for collaborative research. It operates a publicly available website (http://www.osdd.net/) which acts as its primary interface\textsuperscript{16}. The online collaborative platform ‘SysBorg’ (http://sysborg2.osdd.net) works as a virtual laboratory framework for the participants to engage in discussions, share their ideas, organize and manage research projects. Scientists, researchers, students and professionals are encouraged to be part of OSDD by creating a user account on SysBorg. Once account is created, participants can utilize SysBorg as their research platform and use its social networking features to collaborate with other users. This facilitates building up of virtual teams with participants interacting online and contributing to user chosen projects. A significant feature of OSDD is facilitating open access to experimental data and open sharing of ideas and results. The traditional practice of safe guarding results and data till publication has been replaced by SysBorg’s electronic lab notebook which allows entire community to access the data. Participant’s contributions to SysBorg in the form of ideas, concepts, data and results are protected following a unique concept called micro attribution and date and time stamping. This keeps record of all inputs and contributions made by individual participants. SysBorg also facilitates posting of funding requests online. This enables peer-review of each funding request and ensures transparency by allowing community members to evaluate merit of each project.

There is another publicly available CRDD web portal (http://crdd.osdd.net/) that provides access to numerous tools for computational drug discovery. CRDD is an important module of the in silico module of OSDD\(^{17}\). OSDDChem Chemical database (http://crdd.osdd.net/osddchem/) is an open repository of information on synthesized, semi-synthesized, naturally and virtually designed molecules from OSDD community. Anyone who wishes to access or contribute to the database need to be a registered member of OSDD and should have a Sysborg account\(^{18}\). MetaPred (http://crdd.osdd.net/raghava/metapred/) is a web server for the prediction of Cytochrome P450 Isoform responsible for metabolizing a drug molecule. MetaPred series predict metabolizing CYP isoform of a drug molecule/substrate, based on SVM models developed using CDK descriptors. This server will be helpful for researchers working in the field of drug discovery. ‘Compilation and Creation of datasets from PDB’ or ccPDB (http://crdd.osdd.net/raghava/ccpdb/) is a database intended to serve contributors working in the field of function or structure annotation of proteins. KiDoQ (http://crdd.osdd.net/raghava/kidoq/) is another web server of OSDD which will be useful for researchers working in the field of designing inhibitors against Dihydrodipicolinate Synthase (DHDPS), a potential drug target enzyme of a unique bacterial DAP/ Lysine pathway. In addition to all this, OSDD also utilizes social networking sites to interact with participants and publicize its achievements.

The core funding of OSDD was from Government of India. From September 2008 to March 2012 government had earmarked about $12 million for the project. Up to 2012 OSDD was a project under the National Laboratories scheme of CSIR. For the 12\(^{th}\) five-year plan during 2013-17 the planning commission has approved the continuation of OSDD as a part of open innovation scheme of CSIR. From the beginning itself OSDD is proposed to be carried out with public-private partnership.

\(^{17}\) CRDD portal provides computational resources related to drug discovery in a single platform. See <http://crdd.osdd.net/> (accessed 21 September 2016)

\(^{18}\) Details on OSDDChem database available at <http://crdd.osdd.net/osddchem/> (accessed 21 September 2016)
Sri Dorabji Tata Trust has awarded Rs.285.75 lakhs for operating Tata CSIR-OSDD fellowship to support students and young researchers who will participate in OSDD\(^\text{19}\). Significant contribution need to be raised from international agencies and philanthropists for taking the OSDD forward. The major outcomes from the OSDD project include the development of translational platform to convert the valuable scientific findings into drug discovery projects. OSDD had also build up a number of open source facilities to enable the researchers with easily accessible resources. This includes an open source chemical repository, screening facility and many other freely accessible computational tools. The community had also developed OSDDlinux a customized operating system for drug discovery research. As part of OSDD, more than 5000 compounds were screened and the associated biological screening data have been deposited in OSDD ChemDesign database. OSDD had also taken the initiative to involve various CSIR labs and other institutions to build a diverse compound library that would be screened for TB and Malaria. As part of the collaborative research more than 1200 compounds were synthesized and few molecules were identified with preliminary activity against TB and Malaria. At present OSDD working has been considerably stagnated due to lack of sufficient financial support from the government\(^\text{20}\). This has even stalled the proposed clinical trials of a combination called PaMZ (PA-824 + Moxifloxacin + pyrazinamide) which is expected to cut treatment time for multi-drug-resistant tuberculosis by at least a third\(^\text{21}\). At this juncture it is pertinent to note that the 2016 National IPR

\[\text{Details on funding sources of OSDD available at} \ <\text{http://www.osdd.net/about-us/funding}> \text{ (accessed 21 September 2016)}\]

\[\text{The working of OSDD has almost become stagnant primarily due to lack of funding from government. Even though the portal and computational platforms are still operational there is no ongoing activity. See the news paper report for further information. Rema Nagarajan, ‘Funds dry up for drug discovery project’} \ The Times of India \text{ (Mumbai, 1 April 2014)} \ <\text{http://timesofindia.indiatimes.com/india/Funds-dry-up-for-drug-discovery-project/ articleshow/33048063 .cms}> \text{ (accessed 21 September 2016)}\]

\[\text{See for details Jacob Koshy, ‘Fund crunch hits Indian drug trial’} \ The Hindu \text{ (New Delhi, 27 February 2016)} \ <\text{http://www.thehindu.com/sci-tech/health/fund-crunch-hits-indian-drug-trial/ article8286283.ece}> \text{ (accessed 21 September 2016)}\]
Policy of Government of India proclaims to encourage Open Source Drug Discovery for new inventions for prevention, diagnosis and treatment of diseases especially those that are life threatening and those that have high incidence in India\textsuperscript{22}. It also intends to promote ‘infusion of funds to public R&D units’ as a part of corporate social responsibility to foster a culture of open innovation. Even though government is yet to take any proactive step in this regard to accelerate OSDD, the inclusion of it into the National IPR policy signals the governmental intention to rejuvenate it.

5.3 Licensing model of OSDD

OSDD requires the intended participants to become registered users of SysBorg which is the cyber infrastructure developed for collaborative drug discovery research. SysBorg contains all resources to effectively organize collaborations and tools to effectively mine and analyze information collated by OSDD community. All participants are required to agree to ‘OSDD license’ given in a click wrap format during the registration process. As per the license terms, the use of the portal itself constitutes the participant’s acceptance of license terms. OSDD license\textsuperscript{23} govern access of participants to the database and regulate use of knowledge developed through collaborative research. It starts with assertion of OSDD objectives and clearly sets out the vision and mission of OSDD. The OSDD mission statement affirms that the mission is to make available affordable medicines to every single person of the developing world. It aims to bring openness and collaborative spirit in the entire drug discovery process with the objective of keeping drug cost low. In formulating the terms of license, OSDD had focused on the potential problem of third parties acquiring property rights based on the information available in the portal which is generated by OSDD community without contributing the

\textsuperscript{22} The full text of National IPR Policy, 2016 can be accessed at <http://dipp.nic.in/sites/default/files/National_IPR_Policy_English.pdf> (accessed 22 January 2017)

\textsuperscript{23} OSDD license is accessible to members at <http://www.osdd.net/> (accessed 21 September 2016) It is mandatory for all members of OSDD to agree to this license. It is in the form of terms and conditions for using the portal. But it makes a binding contract as per Indian law.
improvements made thereon by them back to OSDD\textsuperscript{24}. OSDD is proposed to work as a collective innovation framework which has numerous participants from diverse backgrounds getting involved. The information updated by them into the database will be accessible to all members. The license clearly asserts that the user is solely responsible for any content that he creates, transmits or display while using the portal and shall indemnify OSDD from any third party claim relating to intellectual property or any other rights.

OSDD license uses a peculiar term 'protected collective information' to refer to the data generated through collaborative research. As per the license, the OSDD Portal, its services, the content, information, and results of collaborative research including, the identification of drug-able non-toxic targets, in vitro and in vivo validation, in silico screening of molecules, lead optimization, pre-clinical toxicity and clinical trials will constitute 'protected collective information'\textsuperscript{25}. All participants by accepting the license agrees that the ownership of ‘protected collective information’ belongs solely to the OSDD and is the proprietary right of OSDD. This will be held in trust on behalf of OSDD by CSIR\textsuperscript{26}. Member participants are free to access the 'protected collective information' and use it for further research. By accepting this license, parties agree that 'protected collective information' is a valuable proprietary right of OSDD and in consideration of the participant accessing the ‘protected collective information’, he promises to submit all further developments or improvements made by him or his agents, to or using the ‘protected collective

\textsuperscript{24} See for details <https://sysborg2.osdd.net/html/portlet/login/terms.jsp> (accessed 9 October 2016)
\textsuperscript{25} See Clause 3.1 of OSDD License available at <http://www.osdd.net/> (accessed 9 October 2016) which reads ‘3.1: The Portal, its services, the content, Information, and results of collaborative research including, but not limited to, the identification of drug-able non-toxic targets, in vitro and in vivo validation, in silico screening of molecules, lead optimization, pre-clinical toxicity and clinical trials will constitute Protected Collective Information. You agree that the ownership of Protected Collective Information belongs solely to the OSDD and is the proprietary right of OSDD, to be held in trust on behalf of OSDD by CSIR to be used to further the Vision and Mission.’
\textsuperscript{26} All assets of OSDD will be held in trust on behalf of OSDD by CSIR. So for practical purposes CSIR is the owner of 'protected collective information' developed through collaborative research.
information’ back to the OSDD to add to the ‘protected collective information’ for others to work on it and make further improvements on it\textsuperscript{27}. Thus just like commonly known open source licenses, ‘OSDD license’ also assumes viral nature by mandating that any member who utilizes ‘protected collective information’ must have an obligation to contribute any addition or improvements made to or using it back to OSDD through its Portal. The OSDD database will be updated with this new input which will also form part of ‘protected collective information’. License asserts that proprietary rights over ‘protected collective information’ rest with OSDD. So any appropriation of the ‘protected collective information’ to acquire proprietary rights will be a violation. With regard to any contribution submitted by any participant to the ‘protected collective information’, the participant is deemed to have assigned a worldwide royalty free non-exclusive license to OSDD for the sole purpose of using such information for furthering the Vision and Mission\textsuperscript{28}. The license also clearly authorizes CSIR to initiate legal action against anybody who appropriates the results of collaborative research without contributing the improvements thereon to OSDD.

If any participant acquires any intellectual property rights by making improvements or modifications on any part of the ‘protected collective information’, he is under an obligation to grant an unencumbered worldwide non-exclusive right to OSDD for use of such rights for further research. OSDD is thus not ruling out the possibility of going for intellectual property protection at some stage. OSDD follows

\textsuperscript{27} Clause 3.2 of OSDD license available at <http://www.osdd.net/> (accessed 9 October 2016) reads ‘3.2 : Anyone accessing the Protected Collective Information has an obligation to contribute any addition or improvements made to or using such Protected Collective Information or any research result or proprietary rights generated out of the Protected Collective Information, except as provided in these Terms, back to OSDD through this Portal to add to the Protected Collective Information. Any appropriation of the Protected Collective Information to acquire proprietary rights which is in violation of its Vision and Mission to will be violation of these Terms, liable to legal action under the applicable laws.’

\textsuperscript{28} See Clause 3.5 of OSDD License which reads ‘3.5: You assign to OSDD the worldwide royalty free non-exclusive license on any Information submitted by you to Protected Collective Information for the sole purpose of use of OSDD members for furthering the Vision and Mission and for that purpose only. It is understood that if your intellectual property rights are used for any purpose contrary to the Vision and Mission, this assignment shall stand unconditionally revoked.’
open source policy with regard to software made available through the portal as well. The source code of all computer programs made available through the portal will be open. In case any participant modifies or improves any such software, he shall also openly make available the source code of such modifications. OSDD license also specifically warns the members from infringing intellectual proprietary rights of third parties. And in case of such infringement the participant is liable to indemnify OSDD against all expenses that may be incurred by result of such breach. The license clearly sets out that OSDD acting through CSIR may license any research result generated out of OSDD to any private third party for the sole purpose of furthering the Vision and Mission of OSDD provided that there shall be no direct monetary gain or other benefit for CSIR out of such assignment. The license thus asserts the ownership of CSIR over the research output and facilitates the CSIR to license out the research result to any third party. This will enable OSDD to get involved in product development partnership with pharmaceutical industry. OSDD has clear intention to rely on the generic industry business model for delivering drugs to the market\textsuperscript{29}. The drugs developed through OSDD model will be made available like a generic drug without any IP encumbrances, so that the generic industry can sell it through their channels anywhere in the world. OSDD users are also free to make improvements, additions and modifications on the ‘protected collective information’, and use it commercially or non-commercially, provided that they must contribute all such improvements, additions and modifications, back to it\textsuperscript{30}. Obviously this is left to the pharmaceutical industry to take up. So a participating private player can utilize the data generated through collaborative research for commercial production of drugs if he has the ability and infrastructure to do so.

\textsuperscript{29} See for details on drug discovery and development strategy of OSDD. <http://www.osdd.net/research-development/discovery-development-statergy> (accessed 9 October 2016)

\textsuperscript{30} Participants are free to use the 'protected collective information' developed through collaborative research for commercial and non-commercial purposes subject only to few conditions. See Clause 4.2 OSDD License reads ‘4.2: You may make improvements, additions and modifications on the Protected Collective Information, and use it commercially or non-commercially, provided that you contribute all such improvements, additions and modifications, back to it.’
Chapter 5

An empirical study on CSIR’s OSDD Project

OSDD license varies considerably with the common models of open source licenses, as it relies on a distinct form of property which they call as ‘protected collective information’ to assert content ownership. This assumes great significance in the context of drug discovery as it can encompass all creative output that emerges from the collaborative research. Otherwise it would have been a real challenge to protect information generated from open collaborative model of drug discovery research. But the assertion of ownership, makes the governance system highly visible to the contributors and gives the impression that actual control over property is going to be exercised. Even though OSDD license mandate open access, significant effort is required to create an account and get access to the portal. Many even points out this as a demotivation for the potential contributors\(^{31}\). This has even invited criticisms that OSDD license is not that open. But at the same time OSDD license leaves no scope for forking, as it asserts content ownership and is viral in the sense that it mandates grant back of all improvements. Moreover, under the license there exists a clear restriction on the use of ‘protected collective information’ by anyone who has not agreed to OSDD license. In commonly seen open source projects, licenses are an effective way of building suitable business models. The licensing choices are mainly dependent upon the business model that the project wants to follow. OSDD intends to partner with the generic industry to deliver the drugs to market. But OSDD license fails in providing sufficient incentives to attract the industry into open source research. The OSDD license clearly asserts that the ownership over ‘protected collective information’ shall rest with CSIR. But at the same time, anybody is free to make improvements, additions and modifications to it, subject to the condition that all such improvements, additions and modifications

shall be contributed back to form part of ‘protected collective information’\textsuperscript{32}. However, ‘protected collective information’ is open for anyone to exploit commercially as well as non-commercially. In fact, the highly restrictive nature of OSDD license may even act as a deterrent for the industry. It is well evident that OSDD intends to follow generic business model to bring the pharmaceutical products to market. OSDD planned to do the drug development part through an open collaborative network with the involvement of academia and industry. OSDD expects that once a lead is reached, generic pharmaceutical industry will step in and fund for clinical trials to take the drug forward. But it is silent as to what incentives exist in OSDD to attract pharmaceutical industry to invest in clinical trials. But at the same time, it is interesting to note that OSDD had plans to carry out clinical trials by its own with the involvement of public funded organizations. OSDD had also made an attempt to do clinical trials for a new combination therapy to MDR-TB patients. However, it did not materialize as OSDD ran into financial crisis. Even while insisting a coerced centralization of ownership over research developed through collaborative production, OSDD license is silent as to the manner in which open source production is to be organized. Thus the challenges that OSDD faces in implementing open source production model needs to be found out through an empirical survey.

5.4 Methodology for Survey

Considering the intellectual property issues in OSDD which needs to be examined, an empirical study based on semi structured questionnaires was chosen as the methodology. A literature survey was done to identify the approaches followed by various authors in doing empirical analysis of various open source models in

\textsuperscript{32} See clause 4.2 of OSDD License which reads ‘4.2 : You may make improvements, additions and modifications on the Protected Collective Information, and use it commercially or non-commercially, provided that you contribute all such improvements, additions and modifications, back to it.’
software. Finally, a questionnaire was developed considering existing literature and from opinions of field experts. Both open ended questions and scale items were used for data collection. An on-line format of the questionnaire developed using ‘google forms’ was used for the survey. Data collection involved primarily a survey among participants registered in OSDD and also from personal or telephonic interviews. The questionnaire was circulated among OSDD members through email and also through personal requests. A total of 64 members participated in the survey. The on-line survey was performed from January 2015 to April 2015. This was followed by personal interviews.

5.4.1 Participant Demography in OSDD

The success of any open source project is highly dependent on its ability to attract participants to whom the work can be crowd-sourced. Contributors of open source projects in software were mainly hobbyists who were either already employed in software industry or who is looking for a job in the industry. At least they were familiar with the production methodology prevailing in the industry and in fact open source projects offered them the possibility of working in a similar production model with much more freedom as to ‘what to create?’ and ‘how to create?’. But drug discovery research requires advanced scientific knowledge and expertise which is difficult to find. More over the organization of production in an open source environment with constant updating of research on a publicly accessible computational platform may not be very familiar to the scientists in pharmaceutical industry who work under a tightly guarded business model. In this context, it becomes puzzling as to how an open source drug discovery project will attract contributors. Survey participants were asked certain questions regarding their occupation, educational qualification, activeness in participation, source of income


34 See Appendix I for Questionnaire used for the survey.
etc. These questions were drafted in such a way to bring out the characteristics of participants who contribute to OSDD project. During the survey, a major hurdle faced was to find volunteers who are active contributors. About 95.3% of the respondents in the survey stated that, they are active participants in OSDD. Among them about 39% stated that they spent about 50 hours a week on the project. 35% of the respondents spent more than 20 hours a week. 13% of the respondents in the survey stated that they spend less than 2 hours a week working for OSDD. Thus majority of the respondents were active participants of OSDD. The respondents were also asked about their educational qualification. About 60% of respondents stated that they have a doctoral degree. Post graduates constituted around 36% and less that 2% were graduate students.

Majority of the contributors in open source software projects were programmers working in software industry or innovative software users who were passionate in programming and wanted to improve the products they use. The lack of direct monetary rewards from open source didn't affect them, as either they were already salaried or were hobbyists who viewed it as an opportunity to improve their

35 User innovators benefit from their on expected use of innovation. Thus they do not require any other incentive to become part of collaborative software development. See Georg Von Krogh and Eric Von Hippel, ‘The promise of research on open source software’ (2006) 52 (7) Management science 975.
skills and signal it to prospective employers. It would be interesting in the context of drug discovery to find out the professional back ground of participants in OSDD. This will help in drawing a comparison with open source software projects and initiating a review as to whether the incentive factors in open source will work in OSDD as well. Thus as part of the survey, the respondents were asked to state their primary occupation. About 23% of the respondents stated that they work at an academic position in government institution. This includes participants working as professors, associate professors and assistant professors. 21% of the respondents were PhD students. Scientists in government service, constituted about 12%. Respondents working in academic position in private institutions came to around 6%. In total around 37% of the participants were salaried employees in government service. This doesn't include the PhD students and Post-Doctoral Fellows whose work is also substantially funded from public exchequer. If this is also included, the total will raise to about 65% of the total respondents. This is indeed a significant figure, as it evidences that the majority of the participants in OSDD could be drawing salary from government. At the same time, the percentage of respondents who receive salary from private sources came to only 8%.
The results of survey also signify the fact that majority of the contributors of OSDD will be from academic field. It comes to around 29% excluding students. If Post-Doctoral Fellows, PhD Students, Post Graduate Students and Graduate students are also added, the total will raise to about 69%. This finding is significantly different from the results of empirical studies done on open source software. Studies done on open source software projects, reveal that majority of their contributors are programmers in industry. Contributors from academia constituted only less than 10%.\(^{36}\) It must be noted that a significant part of early stage pharmaceutical research happens mainly in universities and research institutes\(^{37}\). But the final stage of drug discovery i.e. the product development is often carried out by the pharmaceutical industry alone. Because of this, there is a heavy reliance on the industry to develop new drugs and deliver it to the market. This in turn had resulted in industry emerging as the focus of pharmaceutical research and establishing substantial control over the global public health landscape. Interestingly this is happening at a time when more than four-fifth of all funds for basic research to discover new drugs is coming from public sources\(^{38}\). In this context, the possibility of using the support of academia in advanced stage drug discovery is pointed out as an opportunity for open source drug discovery projects. The survey results show that OSDD has been successful at least to some extent in attracting academia to participate in collaborative research. But lack of sufficient drug discovery professionals from industry is one major challenge that OSDD faces\(^{39}\). Scientists in


academia will have more expertise in basic research and lack of sufficient expertise in product development will be a problem in the long run. OSDD had taken concerted efforts to involve academia and public funded research organizations in the collaborative drug discovery. This is also because OSDD intended to focus primarily on drug discovery and expected that the industry will come forward to do the development part once a potential drug candidate is identified. As a significant percentage of contributors in OSDD are salaried employees either in government or private service, a normal doubt would arise as to how they will balance participation in OSDD with their work priorities and find time to contribute. Exactly this question was asked to respondents during the survey.

![Pie chart showing time allocation]

About 54% of the respondents stated that they found time by integrating OSDD priorities into their work. This means that they integrated OSDD into their routine work, may be by taking projects relevant to OSDD or by choosing an area of work which is relevant for OSDD as well. Post-Doctoral Fellows and PhD students also would have done this by selecting an area relevant to OSDD as their research topic. Another interesting fact is that about 75% of the contributors are using their office hours to participate in OSDD. This could be read together with the finding that majority of the contributors of OSDD are salaried government employees. Another aspect to be noted is that drug discovery research requires expensive infrastructure which is difficult for an individual to own or possess. The hobbyists of open source software projects, mostly had their own computers and participating in open source...
didn't involve any cost for them. But participating in drug discovery requires the participants to have access to high end lab facilities. Surprisingly the survey results show that about 80% of the participants are using lab infrastructures at their workplace for contributing into OSDD. This could be an indication that OSDD has been able to attract participants who has access to research facilities. It also evidences the possibilities of coordinating a network of collaborators who has access to R&D facilities to build an open source model of research for drug discovery.

5.4.2 Funding for Open Source Research

The core financial support for OSDD has been from Government of India. It had plans to raise funding from international agencies and philanthropists. Open source production presupposes that creative contributions will be mainly from volunteers and the financial support will be required only for building the basic infrastructure. Apart from this, projects may directly employ some of the contributors as well. As drug discovery research requires substantial funding, it is a puzzling question as to how the contributors will find resources required for their research. The major chunk of OSDD’s fund was mainly used for building the core infrastructure and financing of some projects. As part of the survey, the participants were asked how they are finding financial resources for their research for contributing to OSDD.
About 34% of the respondents stated that they are relying on research resources available at their work place. Interestingly about 50% of respondents stated that they are receiving direct funding from OSDD. This shall be read together with the fact that OSDD has been providing project funding for doing research on specific targets. Some participants also received Tata-CSIR OSDD fellowship. 9% of the respondents are relying on private funding for research. Only 2% is using their own personal resources. This is also indicating that some form of financial support to the contributors would be essential to take OSDD forward even if the participants have access to research infrastructure. OSDD is being promoted as a solution for the health-care needs of neglected population in third world countries. But for this mission to be successful, OSDD must emerge as a self-sustaining model which has the ability generate its own resources. But at present OSDD is heavily reliant on public exchequer and philanthropists for revenue. This also raises serious concerns about the feasibility of OSDD model in long run.

5.4.3 Contributors’ motivations to participate in OSDD

Open source is an alternative to the common conception that creativity can be stimulated only through economic incentives. It is also a proof that even without financial rewards, innovations can happen. Still it may be puzzling to realize that, there exists an alternative mode of production where people contribute to a project for which they are not directly paid or rewarded. Individual participation in open source collaborations, indicate that there exist urges other than economic considerations that motivate contributors. The available empirical literature also suggests that there could be several non-economic motivational factors which could be persuading individuals to be part of peer-to-peer production. Altruistic motives

40 Tata-CSIR OSDD Fellowship is a monthly grant given to young researchers interested to work with OSDD. It is financially supported by Sri Dorabji Tata Trust.

and even influence of a philosophy can be factors that persuade participants to join
an open source community. The list will also include the desire for peer-recognition,
feeling of competency, personal satisfaction and even the possibilities of future
rewards in terms of capacity building, signaling skills to prospective employers and
even to fulfill personal requirements. Just like the role of publication in academia, in
open source world being 'included in the list of contributors' is considered as a major
achievement. This formal recognition is viewed as an important verifiable reward
for developers.\textsuperscript{42} Interestingly one of the empirical studies report that one respondent
had stated his motivation as 'innate desire to code and code and code until I die'.\textsuperscript{43}
The desire to satisfy that 'innate urge' can itself be a significant factor in triggering
creativity. It is now an agreed fact that socially oriented motivations can override
economic considerations and can generate an environment where the products of
social labor are freely shared. An important objective of this empirical study is to
identify the motivational factors that influence the participants of OSDD. Factors
that could possibly motivate participants, were identified from literature survey of
empirical studies done on open source software and also through discussions with
field experts. Finally, during the survey, the respondents were asked to rate the
various factors that they consider as capable of motivating them to be creative and
contribute to OSDD. Majority of the participants rated 'altruism' as the most
prominent motivational factor. Altruism is an innate desire to contribute towards the
welfare of others. It is widely recognized as an important factor that motivates open
source programmers to participate in collaborative research.\textsuperscript{44} This also signifies that
the objectives of OSDD, that is to contribute towards the public health requirements
of third world population did influence the participants.

\textsuperscript{42} Chaim Fershtman and Neil Gandal, ‘Open source software: Motivation and restrictive

\textsuperscript{43} Hars Alexander and Shaosong Ou, ‘Working for free? Motivations for participating in Open

\textsuperscript{44} Hars Alexander and Shaosong Ou, ‘Working for free? Motivations for participating in Open
Descriptive Statistics

<table>
<thead>
<tr>
<th>Factor</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a noble cause / Altruism</td>
<td>63</td>
<td>9.22</td>
<td>1.905</td>
</tr>
<tr>
<td>Research is fun - challenging / Self Satisfaction</td>
<td>45</td>
<td>7.56</td>
<td>1.960</td>
</tr>
<tr>
<td>Peer-recognition / help me to build a social network of peers</td>
<td>60</td>
<td>7.88</td>
<td>1.497</td>
</tr>
<tr>
<td>Help to improve my knowledge and skills</td>
<td>62</td>
<td>7.79</td>
<td>1.473</td>
</tr>
<tr>
<td>OSDD system of 'Micro attribution'</td>
<td>48</td>
<td>6.31</td>
<td>1.518</td>
</tr>
<tr>
<td>Career advancement</td>
<td>38</td>
<td>5.71</td>
<td>1.450</td>
</tr>
<tr>
<td>Desire to innovate and take patent</td>
<td>19</td>
<td>4.21</td>
<td>1.813</td>
</tr>
<tr>
<td>OSDD research fits within the scope of my work</td>
<td>45</td>
<td>5.20</td>
<td>1.471</td>
</tr>
<tr>
<td>I am paid to do this</td>
<td>30</td>
<td>4.33</td>
<td>2.454</td>
</tr>
<tr>
<td>Other Factors</td>
<td>20</td>
<td>3.35</td>
<td>2.519</td>
</tr>
</tbody>
</table>

Peer-recognition is another factor that the participants identified as influential. Majority of the participants rated it as the second most influential factor. It represents a desire for fame and esteem. Open source ensures fast and frequent feedback for the creators. It also facilitates wider dissemination of creations as the research portal will be accessible freely. Thus the creators will receive wider recognition and appreciation compared to conventional model of research. It also encourages the creator to put in additional effort to perfect his creation. A significant number of the respondents has selected 'help to improve my knowledge and skills' as an important motivational factor. This shows that a significant number of participants perceive OSDD as a place where they can enhance their knowledge and learn new skills. The knowledge and training that the contributors gain will help them in their real life as well. This also evidences the possible role of OSDD for capacity building in drug discovery research. The chance to enhance knowledge and skill is an important factor which may even contribute for future economic rewards for the participant. Only very few participants identified 'desire to take patent' as an influential factor. This evidences that the majority of the participants intends to go in

---

45 Lee Fleming and David M. Waguespack, ‘Brokerage, boundary spanning, and leadership in open innovation communities’ (2007) 18(2) Organization science 167
line with the community philosophy and doesn't want to fork any research.

An analysis of survey results clearly underlines the fact that non-economic motivational factors have higher influence than direct economic rewards in the creative process. It also the evidences the possibilities of organizing open source production in drug discovery.

5.4.4 Alternative Incentive Model in OSDD

OSDD has introduced an alternative incentive model of 'micro-attribution' and 'credit point award' system to motivate its participants. In OSDD, a larger complex problem is broken into simpler and smaller set of activities which could be taken up by individuals. These smaller set of activities are termed as work packets or work packages. Individual's contribution could be in the form of an idea, software data, an

---

46 See for details on ‘micro-attribution’ and ‘credit point award system’ of OSDD. <http://www.osdd.net/about-us/osdd-policies/attribution-authorship-policy> (accessed 9 October 2016)
article or molecule etc. that help in expediting process of drug discovery. Participants are actually free to contribute to any area of their choice. All these contributions will be rewarded by a micro attribution system⁴⁷. Based on peer-review of each contribution, contributors would get rewards in the form of credit points. Each contribution has a pre-determined set of points or rewards associated with it. It means, while assigning the task itself, the difficulty level will be assessed and a proportionate point will be fixed. On the basis of points accrued by each member, they would be awarded four membership cards – Blue, silver, gold and Platinum. Depending upon the type of card, members entail certain sets of rights, privileges and responsibilities in the entire process⁴⁸. There isn't much clarity as to the nature of these rights. Obviously their scope and extent in an open source environment will be understood only by the time OSDD gains full momentum.

![Bar chart showing responses to survey questions](image)

During the survey, respondents were asked to state their opinion on the 'micro-attribution' and 'credit point award' system in OSDD. Many participants opined during personal interview that the 'micro-attribution' system assured due credit to the real contributor. But many were dissatisfied with the 'credit point award' system that it is entangled in the excessive governance present in OSDD. It seems that majority resonated this opinion as about 41% of the respondents opined that present system of 'credit point' awarding is a failure in motivating participants. But at the same time 15%

---

⁴⁷ OSDD proposes a novel system to provide incentive to contributors. This system could be argued to be similar to mechanism followed by online peer-to-peer digital content sharing sites. Details available at <http://www.osdd.net/how-does-osdd-work> (accessed 9 October 2016). OSDD license is not providing any details on these special rights and privileges that may be available to different card-holders. Clarity may be attained by the time OSDD moves forward to next phase.

⁴⁸ OSDD license is not providing any details on these special rights and privileges that may be available to different card-holders.
is of the opinion that it is highly successful as an incentive to contributors. However, the survey result is a clear indication that there is displeasure among participants towards the governance structure of OSDD which awards 'credit points'.

5.4.5 Capacity Building through Open Collaborative Research

Open source represents a culture of reciprocal sharing where participants freely upload their creations to a publicly accessible database. It is an accepted fact that research becomes more efficient and effective when it is done in an open environment. Secrecy often results in inefficient allocation of resources and inability to utilize the resources lying outside the secret circle. But in an open source environment, research output is constantly updated into the project portal which can be reviewed by other members. This ensures that all updates undergo a through scrutiny in the form of peer-review. The uploaded content will again be modified by the contributor or by other members taking into account the suggestions of other participants. Thus collaborative research ensures that the final output will be the resultant of collective wisdom of the participants. In fact, even a passive participation in an open source project will give an incomparable learning experience for a young professional. This is why many participants view open source projects as an opportunity to improve their knowledge and learn new skills.

Involving in open source undoubtedly contributes towards the improvement of knowledge and skill of the participants. A significant percentage of the respondents in the survey had already stated that ‘improving knowledge and skill’ is a major motivational factor for participating in OSDD. The learning experience in OSDD could happen in many ways. One is when a member passively participates in the process and merely observes the contributions of others. This will enable him to understand how creativity happens and challenges in research are being resolved by other participants. In this situation participant is only an observer and community is making no gain from his participation. Respondents in the survey were asked
whether their knowledge and skill has improved by observing the contributions of other members in OSDD. 92% of the respondents have stated that they have gained knowledge and skill by observing contribution of other participants. Among them 75% has strongly agreed to this. This is an empirical evidence that even passive participation in OSDD can lead to capacity building.

My knowledge and skill increased after observing contributions of others in OSDD

Second situation is when a participant after being passive for some time, decide to make a contribution to the project by uploading his own research output. This would offer him a practical learning experience. An important aspect of open source is that it allows the participants to contribute in areas of their choice. In a way, this is actually the freedom to select learning experiences that meet their needs and interests\(^\text{49}\). During the survey about 93% of the respondents stated that their knowledge and skill has further increased after making their own contributions to OSDD.

---

At this juncture a normal doubt will arise as to what would motivate a participant to share his research with OSDD, especially when he has already gained knowledge and skill through observation. It is in this context; the third situation becomes relevant. In OSDD, all submissions made by participants to the project will be subjected to a distributed peer-review process. The other participants will review the content and may even modify or alter it to better suit the requirements of the project. Thus a participant in open source projects would get immediate feedback over the research he has done. This allows the participant to learn from the mistakes he has made and improve his knowledge and skill. The comments and suggestions from other participants will also enable him to improve his research. During the survey the participants were asked whether their knowledge and skill has substantially increased after receiving peer-review and comments on their own contributions. It is interesting to note that 93% of the respondents answered in affirmative while only 1% has expressed disagreement.
My knowledge and skill substantially increased after receiving peer-review and comments on my contributions in OSDD

A comparison of responses in three different situations shows that the learning experience is complete only after the participant makes his own contribution and gets the peer-review. It must be noted that the justification for scientific discoveries come from peer-review. Such review is possible only when the discovery process is shared. Thus sharing of research allows validation of discoveries and facilitates access to information upon which other scientists can build leading to advancement of scientific knowledge\(^{50}\). This also shows that, there exists sufficient incentive for a researcher to be to be part of an open source research network as the ‘opportunity to learn’ would contribute to his own capacity building.

One major benefit expectable from OSDD in the long run is the creation of a community of researchers who has the capacity to pursue drug discovery research. Open research ensures wider technology dissemination. It increases the ability of researchers to access critical research data and creativity of others. Researchers get an opportunity to better understand the product development research in pharmaceutical industry and build their capacity in an area private sector has always dominated. Lack of qualified professionals is a major hurdle faced by third world

countries in meeting public health requirements. Open source drug discovery would be a good platform for researchers to enhance their knowledge and learn new skills in drug discovery research.

5.4.6 Participant's perception towards OSDD's Governance structure

There is a tendency to perceive open source as a chaos, where community of hobbyists collaborate without any proper organization. But contrary to this conception, open source production usually happens in a well-organized framework. The organization of production in open source is implemented through a governance structure which is dominated by the owners of the project. Such governance structure is often represented by a leadership group who are in charge of managing the submissions of participants, assigning credits, taking important decisions etc. The project owners will create the leadership group by asking their own employees to be part of the project and also through creation of an organizational structure among volunteer participants. Being a large scale cooperative network of contributors, open source projects may require governance at different levels. Establishing a formalized governance structure will ensure that the project owners can exercise actual and effective control over the creative process. As open source itself is perceived as a revolt against the increasing control of capital over creative process, volunteer participants will normally have an aversion towards any form of control being exercised over them. Thus active and visible control will demotivate and turn off volunteers. Some projects will even hide their ownership to avoid visibility of control. The success of a project is often dependent on how effectively the governance is imposed without any visible control over the contributors.

In OSDD, there is a clear assertion of ownership over the project. The license makes it very clear that the ownership of the project rests with CSIR. The governance structure of OSDD is also very visible to the participants as it had employees of CSIR directly heading the project and taking important decisions. An
important aspect of the governance system of OSDD was the system of selection of projects for funding. In OSDD, participants can propose projects which will be evaluated and if approved financial support will be provided. OSDD has substantially financed many projects in this way. During the survey, participants were asked about their perception on this.

![Chart showing participant perceptions](chart.png)

About 77% of the participants expressed their displeasure about the project selection method. 19% of the respondents were of the opinion that the present system is a failure. 27% asserted that there is a need to look for an alternative system. But at the same time 22% were satisfied with the present system and opined it as highly efficient and effective. During the personal interviews many participants criticized about the excessive governance present in OSDD. Some even complained that the excessive governance has taken away the pleasures of open culture. They felt that the decision making process is embroiled in bureaucratic order and thus discouraged many from being part of it. In fact, some studies have reported that, volunteers had to wait for days to get their request for joining\(^{51}\) accepted and many had given up in frustration\(^{52}\). This tight control over data has become a barrier for entry. The lack of transparency in OSDD has in fact affected its very foundation as

---

51 Volunteers interested to participate in OSDD will have to sign up through Sysborg portal. Once the request is accepted, volunteer will be intimated through email. Sysborg portal can be accessed at \(<http://sysborg2.osdd.net/web/guest>\) (accessed 22 November 2016).

an open collaborative model. This has invited criticism that OSDD is not fitting within the definitions of open collaboration\(^5\). In fact, too much control has the effect of crippling creativity. This is one of the main reasons for the current stagnancy of OSDD. Actually business organizations try to impose control over the creative process mainly to serve the requirements of their business models. It is the business considerations of project owners that necessitate establishing of control. But as OSDD didn’t have any business objectives to achieve, the well exposed governance structure is of no use in reality. In fact, more creative freedom would have facilitated better research output.

### 5.5 Conclusion

OSDD is promoted as a viable and cost effective solution for the health-care needs of neglected world. But for this mission to be successful, OSDD must emerge as a practical alternative to the contemporary mode of pharmaceutical production. This new model undoubtedly reduces R&D costs in drug discovery by facilitating collaborative research. Just like other models of collective inventions, collaboration speeds up innovation and ensures better results. Pharmaceutics is a sector where IPR protection has practically stagnated knowledge sharing. It is also an area where millions are spent for research and development. If collaborative research is facilitated in an efficient platform it may substantially reduce cost of drug development. This will really be helpful in finding cost effective solutions for neglected diseases in third world countries. OSDD has been successful in attracting volunteers to take part in the initiative. This proves that the non-economic motivational factors or rather the philosophy have the potential to take OSDD to the next level.

---

As of now OSDD permit participants to make commercial and non-commercial use of research output\textsuperscript{54}. That means participants are free to move on to commercial production. This gives a clear advantage to private players from pharmaceutical field. Even a non-contributing participant can go for free-ride in the present system. But it is interesting to ask who will be the real beneficiary of this system. The unpaid volunteers who beeline to contribute got no incentive other than personal satisfaction. But the pharmaceutical companies can easily rely on the data developed by OSDD and move to commercial production. This will significantly reduce their investment in R&D. But so far this has not happened primarily because of the lack of productive output. Moreover, the drug development also requires significant investment and OSDD fails in offering any visible incentive for the industry to take up this part. Lack of intellectual property protection increases the risk of losing the investment for a company as its competitors will also be in a position to exploit the newly developed drug. Further we are yet to see whether the benefits from OSDD will be passed on to consumers. Unless this is ensured, the whole OSDD will become a futile attempt. And the result will be private players getting a free ride at the cost of public funded institutions and volunteering individuals. Another important factor to be noted is that the OSDD license is also silent about the issues that may arise with the commercial production of drugs. This leaves the drug companies from the hurdles of price regulation and IP protection\textsuperscript{55}. But these are all issues which emerge only when OSDD grows to next stage.

\textsuperscript{54} See OSDD license Clause 4.2 which reads ‘You may make improvements, additions and modifications on the Protected Collective Information, and use it commercially or non-commercially, provided that you contribute all such improvements, additions and modifications, back to it.’

\textsuperscript{55} Price regulation clauses are often found in contracts dealing with IP protection of public funded research. OSDD license is totally silent about the pricing issues of final product developed through collaborative research. Details available at <http://www.osdd.net/how-does-osdd-work> (accessed 17 November 2016)
It is disappointing to note that, OSDD doesn't have a financially sustainable model and it expects contributions from public exchequer and philanthropists as its major revenue source. This raises serious concerns about the feasibility of OSDD in the long run. But there exist numerous open source models which survive solely on contributions and voluntarism. Pharmaceuticals have significant differences from such working models. The mass production and distribution of drugs requires the unavoidable involvement of private players inside or outside the collaboration. If OSDD is proposing reliance on the present industrial setup itself for the production and distribution of drugs it miserably fails as an economic model to make any significant change in the existing pattern of capital formation. Apart from facilitating collaborative research OSDD must also emerge as a new economic model having due role in production and distribution. But the proposed project only facilitates collaborative research and leaves it to the participants to go for commercial production or not. It is presumable that individual participants never have the option of commercial utilization because they don't have the ability in terms of industrial infrastructure required for it. Instead of remaining as a facilitator of collaborative research OSDD must be able to bring about a significant change in working of market forces. Even though the collaborative research will substantially reduce R&D costs that may not be reflected proportionately in drug pricing. And sustaining OSDD through public funding will also become impractical in the long run. Thus OSDD must find way to generate revenue for its sustenance while being in the 'open platform' itself. Unless OSDD achieves this through a different modality of capital formation it will never be able to emerge as an alternative to the contemporary pattern of production and wealth generation in pharmaceutical industry. In the light of the experiences of OSDD and examining the


57 OSDD is never planning to step into commercial production of drugs. Its aim is to facilitate research collaboration and thus significantly reduce R&D cost. This implies that drug production based on the research results of OSDD will be done by pharmaceutical companies itself.
open source models followed by major pharma companies it is proposed to examine the challenges of modeling an open source drug development for neglected diseases in the next chapter.